Sustainable Cities: Supplements 1-8 to the Institute of Urban Studies Newsletter

Occasional Paper No. 34

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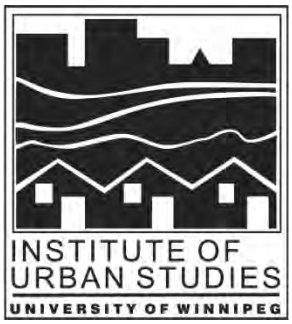
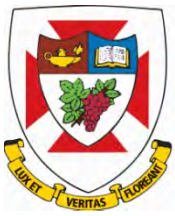
by Jeffrey Patterson
1995

The Institute of Urban Studies





THE UNIVERSITY OF WINNIPEG

FOR INFORMATION:

The Institute of Urban Studies
The University of Winnipeg
599 Portage Avenue, Winnipeg
phone: 204.982.1140
fax: 204.943.4695
general email: ius@uwinnipeg.ca

Mailing Address:
The Institute of Urban Studies
The University of Winnipeg
515 Portage Avenue
Winnipeg, Manitoba, R3B 2E9

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The Institute of Urban Studies is an independent research arm of the University of Winnipeg. Since 1969, the IUS has been both an academic and an applied research centre, committed to examining urban development issues in a broad, non-partisan manner. The Institute examines inner city, environmental, Aboriginal and community development issues. In addition to its ongoing involvement in research, IUS brings in visiting scholars, hosts workshops, seminars and conferences, and acts in partnership with other organizations in the community to effect positive change.

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SUSTAINABLE CITIES

Supplements 1-8 to the Institute of Urban Studies Newsletter

Jeffrey Patterson

INSTITUTE OF URBAN STUDIES

THE UNIVERSITY of WINNIPEG

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FOREWORD

Between December 1991 and the winter of 1994, the Institute of Urban Studies published eight issues of a bulletin entitled *Sustainable Cities* as a supplement to the *Institute of Urban Studies Newsletter*. Each issue covered a topic relevant to sustainable urban development, and reflected the work on urban sustainability being undertaken for IUS by researcher Jeffrey Patterson. *Sustainable Cities* received many compliments from *Newsletter* readers, and a number of university professors used the series in their classes.

Although *Sustainable Cities* is no longer published, the Institute still receives requests for copies of individual issues, or of the whole series. In response to this demand, this collection of all eight issues was conceived.

The *IUS Newsletter* ceased publication shortly after *Sustainable Cities*, in Spring 1994 (No. 45); however, plans are afoot to begin publication of a new periodical with a focus more adapted to the Institute's changing mandate. It is hoped that the new newsletter will cover some of the kinds of issues featured on the pages of *Sustainable Cities*. The IUS Publications Program also boasts a wide range of reports relevant to sustainable urban development, many of which are highlighted on the following pages.

Although *Sustainable Cities* is no longer with us, the problems that it confronts remain. It is hoped that educators, researchers and practitioners will find information on these pages that will help them to address the challenge of sustainable urban development.

Mary Ann Beavis
Institute of Urban Studies

SUSTAINABLE CITIES

ISSUE ■ NO. 1 IUS NEWSLETTER SUPPLEMENT DATE ■ DECEMBER 1991

Introducing Sustainable Cities

The publication nearly two decades ago (1972) of *The Limits to Growth* by Donella Meadows *et al.*, based on models developed at the Massachussetts Institute of Technology, introduced a new urgency into humanity's relationship with the elements. It was stressed for the first time that the capacity of the world's environment to continue to sustain human life and organization as we know them was the most immediate limit to continued economic and demographic growth. While many individuals and organizations have questioned the methods and assumptions on which the mathematical models are based, and while others have asserted that the equilibrating tendencies of the world, its resources and human political and social organization are considerably greater than portrayed by what are characterized as doomsayers, the notion that the world's physical and environmental resources will ultimately place limits on human exploitation has become more commonly accepted. The command over world resources by the Western industrial nations has profound implications for developing nations in the context of environmental limits.

This reality played a major role in the establishment by the United Nations of the World Commission on Environment and Development (WCED), and the publication in 1987 of *Our Common Future*. As a result, it is becoming increasingly accepted that further economic development cannot occur in such a way that it becomes a burden on our descendants. Nor can further economic development of the Western industrial world continue to occur at the expense of the developing world. These conclusions have immense implications for the planning and development of the world's urban areas, particularly in the Western nations, in which approximately 17% of the world's population, two thirds of which is urban, consume approximately 90% of the world's fossil fuels.

Urban planning and development in Canada have barely begun to address the magnitude of the need to reduce consumption of renewable and non-renewable resources, and to increase the efficiency with which they are consumed. As well, the way has been left open to identify all development planning as "sustainable" as long as it leads to improved technique and increased efficiency of resource

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PUBLIC OPINION AND SUSTAINABLE URBAN DEVELOPMENT

The Angus Reid Group's Urban Canada Study, 1991, provides significant insights into public opinion and public choices on a number of issues relevant to the goal of sustainable urban development. These initial public views are of assistance in identifying public preferences and lifestyles and their impact upon the goal of sustainable urban development. Approximately two-thirds of Canadians live in urban agglomerations characterized as "Census Metropolitan Areas." About one-half of Canadians live in the eight cities included in this survey/study. What these urban Canadians think and how they behave will obviously have a large impact on Canada's ability to achieve the goal of sustainability.

Respondents in the eight cities of Vancouver, Calgary, Edmonton, Winnipeg, Toronto, Ottawa, Montreal and Halifax were asked about the potential impact of air pollution on health, their use of and opinion about the public transit system and its performance, the part of town in which they currently live, as well as that in which they would like to live, the degree of attraction of country living outside the city's developed edge, and future public policy preferences with respect to the environment.

Pollution and Health

Respondents were asked on a seven point scale to indicate their agreement with the statement, "I worry about how the pollution in this city affects my health." Two choices are available for analysis. We may focus on average response levels by city or on the "top score" responses, the two highest categories of concern.

Average responses for the eight cities, as may be seen in Table 1, were 4.5 out of a possible 7, reflecting a high degree of concern, but not at a critical level. The results also reflect the overall cleanliness of Canadian cities. As well, this overall result is consistent with the finding that such a concern placed third in the order of concerns of large city Canadians, the first two

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MEASURES OF RELATIVE POLLUTION IN EIGHT CITIES

	Avg.	Van.	Cal.	Edm.	Wpg.	Tor.	Ott.	Mtl.	Halifax
Pollution/Health Index									
Mean Scores Method	1.0	1.0	0.8	0.9	0.9	1.1	0.8	1.1	0.9
Top Scores Method	1.0	1.1	0.6	0.6	0.6	1.2	0.6	1.2	0.8
Environment Canada Monitoring Program-Avg. of 5 indicators	1.0	1.0	1.0	0.9	0.8	1.3	0.9	1.2	0.8

Source: 1. Angus Reid Group, Urban Canada Study, *1991*
2. Environment Canada, *National Urban Air Quality, Trends, 1978-1987 (EPS 7/UP/3) May 1991.*

Table 1

being concern for crime, gangs and drugs and for traffic congestion. Mean scores for the eight cities ranged from 3.7 in Calgary and Ottawa to 4.9 for Montreal, the city in which respondents were most concerned with the impact of pollution on their health. Translation of the mean score for each city to an index where a value of 1.0 represents the mean for the eight cities results in a range of scores of 0.8 to 1.1, which expresses the level of concern of each city's residents relative to the mean level of concern expressed by residents of the other seven cities.

Approximately 37% of respondents said that their level of concern placed them at point 6 or 7 on the seven point scale. Values ranged from 21% for Calgary up to 46% for Toronto. Translating these responses to an index similar to that used above for mean scores results in a range from 0.6 for Calgary, Edmonton, Winnipeg and Ottawa up to 1.2 for Toronto and Montreal.

Measured Pollution

How does subjective opinion on city pollution accord with more objective measurements of pollution? While the question did not specify what kind of pollution may be threatening to health — air, water or soil, it is assumed that respondents felt that air pollution is most significant to their health. While water pollution is also threatening, especially trace elements and compounds found in the drinking water in some of the eight cities, water for daily use is treated to standards that are amongst the world's highest. The provinces and Environment Canada co-operate extensively in monitoring air quality, and it is assumed that the data generated are indicative of air quality in the eight urban centres included in the study. Data are published on the following major contaminants: sulphur dioxide (SO_2); nitrogen dioxide (NO_2); carbon monoxide (CO); ozone; and suspended particulate.

Pollution from SO_2, a colourless gas normally not present in high enough concentrations for its pungent odour to be detected, is emitted mostly by industrial processes, but also from fuel combustion. The latter is more dominant in large urban centres. The composite average concentrations declined by 50% from 1978 to 1986, the last year for which data are available nationally. Between 1982 and 1987, only Halifax and Montreal among the eight cities included in the study had annual averages near the maximum desirable levels established by Environment Canada, although other centres not in the current study, notably Hamilton and Quebec City, had annual averages far above the current standard. Peak concentrations still exceed current maximum standards for the average of all measurement stations.

NO_2, the first step in the formation of "smog", is a reddish-brown gas whose major contributor is engine combustion. Its mean concentration declined by about one-fourth from 1978 to 1987, largely as a result of improvement in the performance of gasoline engines.

CO, produced by the incomplete combustion of fossil fuels, as much as three-fourths in the transport sector, is a major pollutant that can be harmful even in small amounts. The composite average of CO decreased by one-third from 1.5 ppm (parts per million) to 1.0 ppm from 1978-1987.

Ozone is a secondary pollutant resulting from photochemical reactions. In 1987, half the monitoring stations in Canada, principally in southern Ontario, exceeded national standards of 15 ppb (parts per billion), and little change in concentration occurred in the decade leading up to 1987. From 1982 to 1986 four cities, including Montreal and Toronto, had peak hour averages exceeding maximum acceptable standards on more than ten days.

Suspended particulates, the most commonly perceived form of air pollution, arise principally from industrial emissions (50%), fuel combustion, mainly in thermal power plants, transportation and incineration and slash burning. Average concentrations decreased by 20% from 1978 to 1987, and most recording stations had

Introducing Sustainable Cities

Continued from page 1

use and reduced environmental degradation.

Accordingly, the Institute of Urban Studies initiated a major focus on sustainable urban development commencing with its 1991-92 academic program year. The purpose of this program is to encourage enlightened thinking by decision-makers concerned with future urban development, and to investigate the ways and means of improving the quality of the urban environment and of urban living for this and for future generations that is consistent with the notion of sustainability. A research and educational program with elements extending over a three year period is available from the Institute.

The purpose of this supplement to the regular *IUS Newsletter* is to keep our readers abreast of current issues with respect to the subject of sustainable urban development and to provide current information on the status of, and events in, our program on sustainable urban development. The topic of this premiere issue is "Public Opinion and Sustainable Urban Development," as indicated by the Angus Reid Group's Urban Canada Study, 1991. Our colleagues are invited to make contributions and to publicize relevant events and the availability of new materials in this supplement. Please contact Mary Ann Beavis, Research Associate and Editor.

means below national targets, although Calgary and Montreal each had annual means exceeding maximum acceptable levels for at least one year between 1982 and 1986.

While it is not necessarily considered legitimate to combine the results of the different sources of air pollution into a composite measure of air quality, this theoretical exercise can nevertheless be undertaken. Such a composite measure and index for the eight cities included in the Urban Canada Study results in indexes for individual cities that accord reasonably well with the ranks of the eight cities resulting from subjective perceptions. Index values range from 0.8 for Winnipeg and Halifax to a high of 1.3 for Toronto, Canada's first city in both economic activity and air pollution. As can be seen in Table 1, the subjective valuation of the threat posed for health by pollution in the eight cities largely accords with the relative objective measures of air pollution. Only the residents of Calgary and Ottawa tended to overestimate the quality of their air relative to other major urban centres, and this over estimation may represent a halo effect of the overall level of cleanliness of these two centres.

Use and Evaluation of Public Transit

Walking or bicycling to work or alternatively, using public transit, would increase in a system characterized as sustainable, although the substitution of renewable energy forms for transportation for gasoline and related fuels might be compatible with the concept of sustainability, subject to empirically determining the impact of such locomotive fuels on the environment. The burning of non-renewable fossil fuels cannot be rationalized with the concept of sustainability. As well, there are concerns that increased gases resulting from the combustion of fossil fuels, often referred to as "greenhouse" gases, will ultimately lead to global warming. As well, spent tire carcases and discarded cars are major solid waste management problems. A sustainable society would be one in which daily dependence on automobiles would be eliminated, certainly minimized.

Notwithstanding that being outdoors for extended periods in winter in many Canadian cities may be uncomfortable, even harmful, if one is not properly clothed, the first goal in a sustainable society would be the creation of proximity — proximity planning — in such a way that most home-to-work trips could be made by foot and on bicycle. Land use and transportation policy are highly interdependent.

Eight percent of respondents in the Urban Canada Study, 1991, said that they walked or cycled to work. The range was from a low of 6% for Toronto to 15% for Ottawa, the only city to exceed 10%.

These levels compare poorly with estimates of 20-30% for major European cities, but favourably to levels of 4-6 percent for Los Angeles, Chicago, San Francisco and Sydney.

Most of the eight cities do not encourage cycling. Only 21% of national respondents thought that their city provided "lots of" bicycle paths — as low as 3% in Halifax and Winnipeg and as high as 55% in Ottawa, the city where commuters most often walk or cycle to work.

Public transit generally represents the next most preferable means for making home to work trips. As can be seen in Table 2, a diesel bus with 40 passengers consumes slightly more than one-tenth the energy per com-

COMPARISON OF ENERGY USE AND CARBON DIOXIDE EMISSIONS BY TRANSPORTATION MODE

	Efficiency	Energy Use (MJ/pers. km)	CO_2 Emission (gm e/pers km)
Auto (1 commuter)	10L/100 km	3.16	67
Van (6 commuters)	15L/100 km	0.79	17
Van (15 commuters)	20L/100 km	0.42	9
Electric Auto (1 commuter)	150km/30 kwh	0.72	59
Diesel Bus (40 commuters)	56L/100 km	0.52	11
Light Rail Car (41 commuters)	3.02 kwh/km	0.24	20
Subway (75 commuters)	2.61 kwh/km	0.13	11

Source: City of Toronto, 1991. It is assumed that natural gas powers electrical generating stations.

Table 2

HOME-WORK TRANSPORT AND PUBLIC TRANSIT VALUATION

	All %	Van. %	Cal.. %	Edm. %	Wpg. %	Tor. %	Ott. %	Mtl. %	Halifax %
Home-Work Transport									
Car	67	74	76	80	70	57	60	67	74
Public Transit	23	16	14	11	18	35	20	23	14
Cycle or Walk	8	10	7	7	9	6	15	8	11
Public Transit Ratings									
Speed	36	28	39	39	38	41	32	33	32
Frequency of Service	34	26	31	32	36	47	29	29	33
Route Coverage	44	33	31	30	43	58	39	45	39
Reliability	45	35	51	53	55	48	38	44	46
Seating Adequacy	27	18	30	39	34	23	28	32	32
Safety	48	46	47	56	57	51	52	35	48
Very Satisfied	22	16	27	20	27	30	19	15	19
Lots of Bicycle Paths	21	6	52	21	3	13	55	29	3
Should Encourage Transit Use	73	80	66	63	60	78	70	70	62
Service Preference Type									
Basic	8	4	8	7	9	7	11	12	13
Comprehensive	44	55	31	35	32	51	37	42	31

Source: Angus Reid Group, Urban Canada Study, *1991.*

Table 3

muter of a car with one passenger, and it emits the same ratio of CO_2 into the atmosphere.

Table 3 shows that only 23% of respondents in the eight cities regularly used public transit to commute to and from work, varying from a low of 11 percent for Edmonton to a high of 35 percent for Toronto. The proportion in the other six cities varied in a narrow range between 14% (Calgary and Halifax) and 23% (Montreal) of all home-to-work trips.

The data lead to the conclusion that the public's view of transit performance is not positive, although there was considerable variation around a national average for the eight cities. Only 36%, although still greater than actually used it, agreed that speed was satisfactory, ranging from a low of 28% for Vancouver to a high of 41% in Toronto. Only 34% agreed that frequency of service was adequate. This assessment ranged from 26% in Vancouver up to 47% in Toronto. And only 27% thought that there were adequate numbers of seats, ranging from 18% for Vancouver to 39% for Edmonton, the city with the lowest ridership. A significantly larger proportion thought that route coverage was adequate: 44%, ranging from 30% in Edmonton to 58% in Toronto. Forty-five percent thought that service was reliable, ranging from 35% for Vancouver to 55% for Winnipeg.

Overall, 22% of urban Canadians, about the same proportion as actually make use of public transit, were "very" satisfied with the service provided. Toronto, where 30% were very satisfied, emerged as having the best transit system, while Montreal and Vancouver with 15 and 16%, respectively, very satisfied with service emerged as the two cities with the least satisfactory public transit. About half of all respondents gave some feature of the transit system itself — inaccessible, inconvenient, a hassle, too slow, or poor route coverage as the reason they did not regularly use transit for home and work commuting. Slightly fewer indicated that they either preferred their vehicle or that an owned vehicle was more convenient.

Almost exactly two-thirds of Canadians in large cities use a car for daily commutation from home to work, over 90% of those who also indicated that they owned and made regular use a car. The proportion varied from a low of 57% for Toronto, Canada's most transit-oriented major city, to a high of 80% for Edmonton, the most auto-dependent city.

APPEAL AND LIKELIHOOD OF RURAL LIVING

	Avg. %	Van. %	Cal. %	Edm. %	Wpg. %	Tor. %	Ott. %	Mtl. %	Halifax %
Rural Residence Appeal									
A lot or some	52	55	46	51	51	53	55	57	47
Likelihood Very High in 5 years	17	16	9	12	12	21	13	19	18

Source: Angus Reid Group, Urban Canada Study, *1991.*

Table 4

Nevertheless, Canadians overwhelmingly agree — 73%— that public transit use should be encouraged for environmental reasons, and this proportion did not vary significantly among the eight urban centres. Most Canadians agree that public transit is good for the environment and its use should be encouraged, but they appear to be a long way from using it themselves, and many are obviously not overly impressed with public transit's performance.

There is less agreement on what kind of transit system should be encouraged. While only a small minority responded positively to the notion that a "basic" system serving mainly the elderly and others without access to private cars, only in Toronto and Vancouver did a majority of respondents think that a "comprehensive" system should be offered. The proportion favouring a comprehensive system in the other six cities varied from a low of 31% in Calgary and Halifax to a high of 42% in Montreal. The remainder felt that a "reliable" system should be made available.

Canadians nevertheless use public transit to commute to work much more frequently than their "cousins" in the United States, and the level of satisfaction with what is currently available is conducive to this use. Regular public transit use in the largest American cities — 18% in Chicago and 17% in San Francisco — is roughly equivalent to that in middle sized Canadian urban centres: 20% in Ottawa and 18% in Winnipeg. Even the 11% ridership level in Edmonton, apparently Canada's most auto-dependent city, exceeds the 8% level in Los Angeles, usually characterized as the epitome of an auto-oriented city.

Where Do Urbanites Want to Live?

Low auto dependence and high use of public transit is usually characteristic of high density cities. As already observed, land use and transportation policies are mutually supportive and highly interdependent. It is therefore important to examine where Canadians want to live within their cities, as it is generally agreed that auto dependence will decrease only if denser patterns of urban life are realized, although the relationship between home and work could be better articulated no matter what densities characterize existing and future urban development.

One of the more overwhelming conclusions of the Urban Canada Study, 1991, would seem to be that Canadians would prefer to live more sparsely than they already do, and perhaps very much more sparsely than they now do, hardly conducive to achieving the goal of sustainability, unless proximity of home and work can be improved at the same time. Respondents were asked to indicate the level of appeal of living beyond the built-up area of the city, either in a small community or in a rural area, had for them. The results are summarized in Table 4. Positive responses to this query were overwhelming: 52% replied that this notion possessed some or a lot of appeal for themselves, and variation amongst residents of the eight cities was not great. The high

end of the spectrum, 57%, was represented by Montreal, the city with the lowest overall quality of life, while the low end, 46% was represented by Calgary, the city with the best overall quality of life. The appeal of living in a small community or rural area appears to be closely identified in the larger centres with their attendant high levels of daily stress. It seems that the majority of Canadians do not like large cities and what they represent at all.

It is unlikely that so many Canadians will be able to take advantage of the appeal of living in a small community or rural area in the immediate future. House construction, and perhaps more importantly, subdivision approval in environmentally sensitive rural areas, are not anticipated to reach such high levels. Respondents were therefore asked about the likelihood of realizing their ambition in the next five years, and 17% replied that it was very likely. Again, the range of responses was narrow. Toronto, whose inhabitants were also the least satisfied with their current housing situation, represented the high end of likelihood — 21% — and Calgary represented the low end, 16% saying that they were very likely to take advantage of this appeal in the coming five years.

A preference for small community or rural living represents one level of dream or fantasy for urban Canadians. As urban Canadians seem ready to acknowledge, even most of those for whom exurban living has a lot of appeal will not be able to exercise these ideals. Respondents were also asked what part of the city — downtown, other inner city, old suburb or new suburb — in which they currently lived and in which part would they prefer to live, and the results are portrayed in Table 5.

While their place of residence represents their own subjective opinion, which may require more objective confirmation, the congruence or lack of it of desired place of residence with perceived current place of residence probably does represent accurately respondents degree of satisfaction with the part of town in which they currently live, and the attractiveness of some alternative image of another part of town and maybe even a different lifestyle.

Large city Canadians are generally satisfied with their current housing situation, and they also appear to be satisfied with the location of their residence on the continuum stretching from downtown to the edge of the new suburbs. Twenty-two percent said that they lived downtown and/or in the inner city, and 22% — not necessarily the same 22% — said that their preferred residential location was downtown or elsewhere in the inner city. Older suburbs not too far from downtown are the current place of residence of 45% of large city Canadians, but only 39% would prefer to live in an older suburb. Newer suburbs are the location of 32% of large city Canadians, while 36% would like to live in new suburbs.

While what is truly represented by these preferences — fear of unsafe neighbourhoods, the seeking of greener gardens or newer homes with lower maintenance, moving closer to jobs that may also be leaving inner city or downtown locations — is subject to interpretation and speculation, it can generally be concluded that large city Canadians want to live in lower density situations. In most cases, these locations will be less easily served by adequate public transportation than older suburban areas, and certainly less easily served than inner city or downtown areas. As well, walking or cycling to work is generally less likely in newer suburbs than it is in downtown or inner city areas.

However, there is also considerable variation in desires from city to city. The proportion of respondents who characterize themselves as living downtown or elsewhere in the inner city is generally lower in the newer, Western cities, but varies from a low of 13% in Edmonton to a high of 32% in Ottawa. Those two cities also represent the low and the high with respect to the proportion of respondents who would prefer to live downtown or elsewhere in the inner city, 11% and 30% respectively.

The average proportion of respondents characterizing themselves as currently living in a newer suburb at the time of the survey varied from a low of 21% in Toronto to a high of 45% in Edmonton. Preference for living in newer suburbs in the future ranged from a low of 26% for Ottawa to a high of 51% in Edmonton.

The variation in the relative attractiveness or not of living in various parts of town, which is shown in Table 5, may be instructive for urban political decision-makers and local officials and planners. Generally, people want to live where they are now, and the easiest explanation for such a preference is that people tend to like that which is familiar — inertia. Overall across the eight cities, however, the ratio of those who would prefer to live in older suburbs to those who currently live in such areas is 0.9, while the ratio of those who would prefer to live in a new suburb to those who currently do is 1.1.

The survey data indicate that Vancouverites are the only large city Canadians that would on the whole

CURRENT AND PREFERRED RESIDENCE LOCATION

	Avg. %	Van. %	Cal. %	Edm. %	Wpg. %	Tor. %	Ott. %	Mtl. %	Halifax %
Current Residence Location									
Downtown or Inner City	22	17	14	13	19	26	32	21	24
Older Suburb	45	43	45	39	43	52	45	41	37
New Suburb	32	36	41	45	37	21	22	35	38
Preferred Residence Location									
Downtown or Inner City	22	22	16	11	12	26	30	20	26
Older Suburb	39	40	40	34	40	42	39	37	31
New Suburb	36	33	40	51	45	28	26	40	38
Ratio, Preferred to Current Location									
Downtown or Inner City	1.0	1.3	1.1	0.8	0.6	1.0	0.9	1.0	1.1
Older Suburb	0.9	0.9	0.9	0.9	0.9	0.8	0.9	0.9	0.8
New Suburb	1.1	0.9	1.0	1.1	1.2	1.3	1.2	1.1	1.0

Source: Angus Reid Group, Urban Canada Study, *1991.*

Table 5

TOP PRIORITIES OF LARGE CITY CANADIANS

	Ave. %	Van. %	Cal. %	Edm. %	Wpg. %	Tor. %	Ott. %	Mtl. %	Halifax %
Total Mentions									
Crime/Violence-General	29	29	22	25	16	42	24	25	14
Economic Development	17	11	19	14	16	12	17	29	16
Police-Better Quality or More	17	12	14	15	15	20	12	21	17
Environment/Pollution	14	14	14	9	11	15	13	16	10
Ethnic/Racial Terrorism	10	10	9	4	7	9	3	18	11
Public Transit	9	20	4	6	4	7	7	8	4
Municipal Infrastructure	8	8	5	14	10	3	5	13	6
Helping Poor/Homeless	7	5	3	4	3	7	6	16	4
Social Services	7	6	8	11	5	7	8	4	6
Affordable Housing	6	10	3	3	3	9	8	4	3
Recycling	6	7	6	5	6	4	8	6	9
Better Waste/Management	6	5	3	12	1	6	6	7	5

Source: Angus Reid Group, Urban Canada Study, *1991.*

Table 6

prefer to live more densely. The ratio of preference for inner city residence in the future to current inner city residence is 1.3 — 30% more Vancouverites would like to live downtown or in the inner city than currently do. Concomitantly, the ratios for older and newer suburbs were 0.9. In only two of the other eight cities, Calgary and Halifax, does the proportion of respondents wishing to live in downtown/inner city exceed the current proportion.

Winnipeg has the downtown/inner city that people would most like to leave. The ratio of the proportion who prefer a downtown/inner city location to those who currently live in such an area is 0.6. It appears that most of the malcontents would like to move to newer suburbs. Winnipeggers also gave their downtown the lowest satisfaction levels among Canada's major cities in the Urban Canada Study, 1991. Two other cities, Edmonton and Ottawa, also had ratios less than unity.

Toronto was the city whose residents want to move to the new suburbs in the largest proportions. The ratio of preference for residence in a new suburb to the proportion currently residing in such areas was 1.3. However, on balance it is the older suburbs, where a ratio of 0.8 obtains, that represent the least preferred location in the Toronto case. In addition to wanting to live outside the built-up urban area in larger proportions than any other large city Canadians, Torontonians want more than other large city Canadians to live in the newer suburbs. Again, motives are subject to interpretation. Is this because such areas are attractive in themselves? because jobs are decentralizing? or because respondents are unhappy with their current housing situation and believe that they can gain satisfactory housing only by living distant from the city centre? Whatever the explanation or combination of causes, those who would put a halt to further suburbanization in Toronto may have a difficult time in the near future.

Future Policies and Priorities

Respondents were asked, "Out of all the areas of municipal concern which we've discussed, or others that you could think of, which one do you feel should be the top priority?" Twelve items were mentioned by more than 5% of large city Canadians, and four — environment/pollution, public transit, recycling and better waste management — are environmental/sustainable urban development issues. A priority for the environment/pollution received the fourth most frequent number of mentions, behind crime and violence, economic development and the need for better quality police. Public transportation received the sixth most frequent mentions by large city Canadians overall. While the environment is fairly high on the list of priorities of large city Canadians, "bread and butter" issues, chiefly safety and economic development, currently dominate the current concerns of urbanites, as well as their future priorities. The results of the study are nevertheless evidence that the environment and pollution are of high secondary concern to large city Canadians.

The environment ranked third in Vancouver, Calgary, Winnipeg, Toronto and Ottawa. It was fifth place in Halifax, while it was tied for fifth place in Montreal. It ranked seventh among all mentions by Edmontonians. However, better waste management and disposal received the fourth most mentions by residents of Edmonton. While public transit ranked sixth on the order of priorities of all large city Canadians, it ranked second in Vancouver. Table 6 summarizes responses by city.

Conclusion

Public opinion, as is perhaps demonstrated best by the vicissitudes of political party preference, is fickle and malleable over time. However, no matter how variable or how malleable to media and current events influence, public opinion nevertheless allows us to measure where the public is and what is it's opinion on current issues.

As is shown in the above, the environment and sustainability are not currently uppermost in public priorities. This says a lot for what has already been accomplished. It also says a lot about current preoccupations in Canada's large urban centres at the end of 1991: crime, policing, and traffic congestion.

However, this tentative analysis of the Urban Canada Study, 1991, has only begun to scratch the surface. Subjecting the data to further analysis and disaggregation will allow us to better to understand public opinion, especially as it has an impact on achieving sustainable urban development.

Jeffrey Patterson
Senior Research Fellow

IUS PUBLICATIONS ON ENVIRONMENTAL AND RELATED ISSUES

S. Michelle Driedger. *Community Involvement in the Site-Selection Process: A Matter of Citizen Participation-The Manitoba Hazardous Waste Management Corporation.* 1991. 16 pp. + ii. $3.00. Student Paper 3.

Although the Manitoba Hazardous Waste Management Corporation has expressed a commitment to genuine public participation in the site selection process for a hazardous waste management facility, the reality has fallen short of this ideal. Driedger points out that the Corporation has a double standard for the City of Winnipeg, where "community" approval is defined in terms of Council support, and rural municipalities, where "community" is defined in terms of individuals living in the area. She evaluates the Corporation's consultative process, at the time of writing, using Sherry Arnstein's ladder of citizen participation, and concludes that the public participation process amounts to tokenism–citizens may be heard, but they are not heeded. The report concludes with a recommendation for change to bring about genuine citizen participation.

Brijesh Mathur, ed. *Perspectives on Urban Health.* 1991. 61 pp. + iv. $12.00. Health and the Community 2.

This publication contains five papers on urban health presented at the Canadian Urban and Housing Studies Conference held at The University of Winnipeg in February 1988. The papers provide an overview of some of the concepts and issues that have emerged within the field in recent years. Papers examine topics such as how the definition of health has evolved and how health promotion is now seen as an important means to achieving better health; the approaches to health promotion; the issues in urban health; the concepts behind the Healthy Communities project; and the role which urban planning can play in achieving the goals of the Healthy Communities Project.

Mary Ann Beavis, ed. *Ethical Dimensions of Sustainable Development and Urbanization: Seminar Papers.*1990. 148 pp. + iv. $20.00. Occasional Paper 23.

Until very recently, the notion of sustainable development had been applied mainly to non-urban settings. From October 1989-April 1990, an interdisciplinary group of academics, professionals and students met at The University of Winnipeg to discuss the issue of sustainable development and urbanization as it relates to applied ethics. Papers presented to the seminar were: "Autonomy, Responsibility, Self Reliance: Assessing Sustainable Development in an Urban Context" by Susan Wismer; "Community Planning and Sustainable Urban Development" by Brij Mathur; "The Place of Recycling in Sustainable Development" by Peter Miller; "The Rivers of Downtown Winnipeg—An Environmental Assessment" by Andy Lockery; "Sustainable Development and Urban Policy in Winnipeg" by Phil Wichen; and "The Responsibility of Urban Dwellers to Foster Sustainable Rural Communities" by John Everitt, Robert Annis and Fred McGuinness. A paper by Joel Novek and Karen Kampen, "Hard Copies, Hard Choices: Paper Pollution in the Information Society" is also included in the collection.

Brijesh Mathur and Mary Ann Beavis, eds. *Towards Stewardship of Winnipeg's River Corridors: Conference Proceedings (Second Winnipeg Rivers Conference).* 1990. a pp. $12.00. Occasional Paper 20.

On November 3 – 4, 1989, the Institute of Urban Studies held its second conference on Winnipeg's rivers, in response to the proposal of a Riverfront Corporation by Manitoba Urban Affairs. Papers include: "Environmental Issues in the Winnipeg River Corridor" by Andy Lockery; "Issues in Conservation and Development" by Doug Clark; "A Bold Vision for Winnipeg's Rivers" by Elizabeth Ballantyne; "Uses of Winnipeg's River Corridors" by Wesley Paetkau and Rick Penner; "Land That is Not Owned: Towards a Winnipeg Commons" by Ross Dobson; "Canadian Responses to Riverbanks: The Special Agency Approach (Saskatoon's Meewasin Valley Authority)" by Kenneth P. Pontikes; and "The National Capital Commission: Perspectives on River Corridor Management in the National Capital" by Richard Scott.

Barbara J. Lane. *The Canadian Healthy Communities Project: A Conceptual Model for Winnipeg.* 1989. 115 pp. $17.00. Health and the Community 1.

The World Health Organization's challenge for Health For All by the Year 2000 has stimulated varied responses from the developed world; in Canada, it led to *Achieving Health for All: A Framework for Health Promotion* and a revitalization of Canadian Public Health. The Canadian Healthy Communities Project is part of that response, and offers a way of making real the concepts of the *Framework.*

Recognizing the need for a Healthy Communities model that would provide operational definitions and delineate responsibilities for project implementation, IUS facilitated a Healthy Communities Study which would include a general model, but with particular reference to Winnipeg, a study carried out in the 1988 - 89 academic year while the author was on sabbatical leave from the University of Saskatchewan. This report includes a discussion of the origins and development of the "new public health" and the Healthy Cities/Healthy Communities Project; a review of selected projects in the U.K, the U.S. and Canada; an overview of social and health characteristics of population subgroups of Winnipeg; and a discussion of organization and decision-making in municipal government in the city. The report presents "The Winnipeg Model," a process model which accommodates the inter-sectoral collaboration and meaningful public participation central to the project, without requiring a restructuring of existing decision-making processes.

Don Epstein. *Unban Rivers—Expanding Our Vision: The 1985 Winnipeg Rivers Conference Sumary.* 1986. 25 pp. Sale price $3.00. Occasional Paper 16.

The first Winnipeg Rivers Conference sponsored by IUS was held at The University of Winnipeg, October 1985. This summary and commentary on the conference focuses on major problems and constrains to riverbank and waterway development, and on various developmental and organizational visions for Winnipeg's rivers, especially with respect to the redevelopment of the CN East Yards and The Forks.

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SUSTAINABLE CITIES

ISSUE ■ NO. 2 IUS NEWSLETTER SUPPLEMENT DATE ■ SPRING 1992

TRANSPORT TO WORK: EIGHT SELECTED CITIES

In Issue No. 1 of ***Sustainable Cities*** *and in the* ***IUS Newsletter,*** *December 1991 edition, the Angus Reid Group's* ***Urban Canada Study, 1991,*** *was introduced. In this issue of* ***Sustainable Cities,*** *the behaviour of large-city Canadians with respect to mode of transport for trips to work is examined.*

Two of the most important issues for sustainable urban development are energy use, especially the consumption of non-renewable fossil fuels, and the emission of air pollutants and greenhouse gases from fuel combustion. One of the principal uses of fossil fuels in urban areas is for space heating. However, there are currently affordable substitutes for fossil fuels in space heating, and while the cost may not be in hand, the Western industrial world certainly possesses technologies for reducing the need for space heating and/or fossil fuels for heating considerably.

Industrial societies have made relatively less progress with respect to reducing the consumption of fossil fuels for both intra- and inter-urban transportation of goods, services and people. Reductions in consumption have been almost wholly the result of reducing vehicle weight and power. As well, most of the advances were made in the late 1970s and early 1980s.

While the technologies for reducing harmful ground-level emissions associated with transportation exist to a greater extent than they have been used, there seem to be limits to the extent that these may be employed. As well, our ability to reduce greenhouse gas emissions appears to be more limited than our ability to reduce other emissions and ground air pollutants. Greenhouse gas emissions are of concern because it is thought that current levels of production will lead to massive climate change and global warming in the long term.

While the ozone layer, which is critical in limiting the transmission of ultra-violet (UV) rays from the sun, may be decreasing in the upper atmosphere, its increase in the lower atmosphere in Canada continues. Ozone in the lower atmosphere is formed as a result of a series of photochemical reactions in the air energized by temperature and sunlight in a stagnant air mass. Transportation is responsible for approximately one half of national emissions, and intra-urban transportation of people is responsible for over 80% of total urban emissions from the transportation sector.[1] Mean annual emissions of ozone increased by 7% from 1978 to 1987. The proportion of stations with maximum annual readings greater than the maximum acceptable by Environment Canada increased from 50% to 57% in the same period.[2] Cities in "central Canada" generally have the highest readings.

The transportation sector produces about 30% of Canada's CO_2 (the most common greenhouse gas) emissions, and 63% of this amount is produced by cars and buses.[3] Assuming that emissions in "have-not" countries were to continue to increase at 5% per annum, the "have" countries would have to decrease their emissions by 20% below 1988 levels to achieve constant total world emissions from 1988 to 2005. Reaching a 2005 target of 20% fewer world emissions than in 1988 would require the have countries to reduce their emissions to levels obtained in the early 1950s, and the have-not countries to maintain constant emission lev-

Nancy Klos

Transport to Work: Private cars vs. Public Transit

els from 1988 to 2005.[4]

Urban Transportation Sector Critical to Healthier Air and Sustainable Development

Reducing the consumption of transportation services, including the use of intra-urban transportation of people, is critical to achieving particular targets with respect to environmental degradation of air in urban regions and more general targets with respect to sustainable development. The urban transport sector, like others, is a complex one. Adjustment of any number of supply or demand variables will influence transport services demand. It is well established that the demand for different transportation services is influenced by household income levels. The price of gasoline, more than half of which already consists in Canada of federal and provincial taxes, also influences final demand. The supply of public transit services, roads and parking also influences choice of transportation mode, especially for trips to work.

The Angus Reid Group's *Urban Canada Study, 1991*, allows urban analysts to examine the relationship of a number of factors with the demand for different modes of transport for trips to work in the eight cities included in the national survey. In the following, the relationship of income and car ownership, and use and the relationship between use of transport mode to work and location of work and residence, are examined for the eight cities.

Income and Car Ownership and Use

Household income is one of the most reliable predictors of both car ownership and the use of cars for work trips by large city Canadians. Almost exactly two thirds of all trips to work in major Canadian cities are by car. Fewer than half of work trips (48%) are by car for households with incomes less than $30,000 (Table 1), while 77% of workers from households with incomes $60,000 and over in 1991 got to work by car. While the relationship between use of cars for trips to work and income obtained in all eight cities, the absolute proportions varied for the eight cities. The proportion of those representing lower income households taking their cars to work varied from 34% in Ottawa up to 63% for Edmonton, the centre whose workers rely most on public transport. Toronto, where 66% of workers choose to get to work by car, and Edmonton at 92%, represent the extremes for workers from higher income households.

The strongest relationship between household income levels and choice of car for work trips appears to exist in Winnipeg. While only 38% of workers from lower income households get to work by car, as many as 80% of middle-income workers and 89% of workers from higher income households get to work by car, including those who are passengers.

Car ownership in itself may be a good predictor of the tendency to choose cars for trips to work. Almost 80% of those owning a car use a car to get to work, although 17% of those not owning cars get to work by car (Table 2). Those not owning cars are particularly likely to get to work by public transit (59%) or by walking or cycling (20%) (Table 2). However, it is also true that the perceived need to go to work and/or to make non-work trips by car influences the decision to purchase cars, or for many households to own two or more. The rate of individual car ownership in Calgary and Edmonton was 92%, while it was only 75% for Toronto workers.

Table 1

CARS AS WORK TRANSPORT MODE AND HOUSEHOLD INCOME

	All %	Van %	Cal %	Edm %	Wpg %	Tor %	Ott %	Mtl %	Hfx %
Income									
Low (< $30,000)	48	46	56	63	38	40	34	57	52
Middle ($30,000 - $59,999)	68	74	79	84	80	54	60	64	73
High ($60,000 +)	77	89	86	92	89	66	72	75	86
Total	67	74	76	80	70	57	60	67	74

Source: Angus Reid Group, *Urban Canada Study, 1991*, IUS tabulations

Table 2

CAR OWNERSHIP AND TRANSPORTATION TO WORK

	All %	Van %	Cal %	Edm %	Wpg %	Tor %	Ott %	Mtl %	Hfx %
Car Ownership									
Yes	(81)	(85)	(92)	(92)	(83)	(75)	(78)	(79)	(80)
Car	78	83	80	86	78	70	73	82	85
Public Transit	14	10	11	6	13	24	13	14	7
Walk or Cycle	6	7	6	6	6	5	10	3	5
No	(19)	(15)	(8)	(8)	(17)	(25)	(22)	(21)	(20)
Car	17	25	28	15	30	17	14	9	15
Public Transit	59	52	50	61	39	70	48	58	43
Walk or Cycle	20	23	22	16	20	11	35	26	34

Source: Angus Reid Group, *Urban Canada Study, 1991*, IUS tabulations

Table 3

TRANSPORTATION TO WORK, PLACE OF WORK AND PLACE OF RESIDENCE

Transport to Work Mode	All %	Van %	Cal %	Edm %	Wpg %	Tor %	Ott %	Mtl %	Hfx %
Live in Downtown Centre	(5)	(5)	(2)	(3)	(5)	(5)	(8)	(4)	(6)
Work Downtown	(64)	(70)	(100)*	(50)*	(38)	(61)	(73)	(67)	(60)
Car	22	36	18	36	nil	10	11	37	24
Public Transit	37	29	32	28	20	57	22	35	33
Walk/Cycle	38	34	50	36	40	32	61	28	43
Work Elsewhere	(36)	(30)	nil*	(50)*	(62)	(39)	(27)	(33)	(40)
Car	63	62	-	100*	55	53	58	76	50
Public Transit	18	38	-	nil	10	32	nil	nil	26
Walk/Cycle	16	nil	-	nil	24	15	28	24	24
Live in Older, Inner City	(17)	(14)	(10)	(9)	(15)	(24)	(23)	(18)	(12)
Work Downtown	(46)	(44)	(37)	(17)	(48)	(59)	(50)	(29)	(60)
Car	38	42	13	52	21	40	44	32	47
Public Transit	42	38	38	48	39	46	24	52	20
Walk/Cycle	19	20	36	nil	36	14	32	8	34
Work Elsewhere	(54)	(56)	(63)	(83)	(52)	(41)	(50)	(71)	(40)
Car	63	54	71	78	75	63	62	61	49
Public Transit	20	19	6	5	13	31	9	21	28
Walk/Cycle	15	27	24	8	12	3	23	18	24
Live in Older Suburb	(43)	(40)	(43)	(41)	(38)	(49)	(44)	(39)	(39)
Work Downtown	(38)	(32)	(33)	(28)	(36)	(45)	(38)	(35)	(48)
Car	47	76	54	59	54	38	46	31	72
Public Transit	44	22	37	24	41	56	40	56	15
Walk/Cycle	3	3	3	11	nil	1	10	4	7
Work Elsewhere	(62)	(68)	(67)	(72)	(64)	(55)	(62)	(65)	(52)
Car	77	75	85	82	79	69	77	81	72
Public Transit	14	12	10	7	10	22	14	14	8
Walk/Cycle	8	13	4	11	5	7	6	4	10
Live in New Suburbs	(34)	(38)	(46)	(46)	(42)	(22)	(24)	(38)	(44)
Work Downtown	(29)	(28)	(34)	(23)	(36)	(26)	(42)	(21)	(38)
Car	64	69	54	73	72	46	66	52	76
Public Transit	32	28	37	22	26	54	27	45	14
Walk/Cycle	1	4	3	nil	2	nil	3	nil	4
Work Elsewhere	(71)	(72)	(66)	(77)	(64)	(74)	(58)	(79)	(62)
Car	87	92	85	88	86	85	75	85	82
Public Transit	7	5	10	5	3	13	10	7	13
Walk/Cycle	5	3	4	5	7	2	10	8	5
Total	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)
Work Downtown	(37)	(34)	(35)	(25)	(38)	(45)	(44)	(30)	(46)
Car	48	63	57	63	52	38	45	37	66
Public Transit	40	28	29	25	34	53	32	50	17
Walk/Cycle	9	9	8	7	10	7	21	6	13
Work Elsewhere	(63)	(66)	(65)	(75)	(62)	(55)	(56)	(70)	(54)
Car	78	79	86	85	81	72	72	79	74
Public Transit	12	11	6	6	8	21	11	12	13
Walk/Cycle	8	10	7	7	8	5	12	9	9

Source: Angus Reid Group, *Urban Canada Study, 1991,* IUS tabulations

Note: Numbers may not add to 100 percent due to rounding and exclusion of "other" and "non-response" categories.
* Errors from small numbers likely.

Transportation Behaviour and Location of Work and Home

Both the relationship between home and work and their location in the overall urban fabric influence the choice of mode of transportation to work (Table 3). Overall, for the eight cities, the proportion of those working downtown–37% of total respondents working outside the home worked downtown–who get to work by car, either as a driver or as a passenger, was less than half (48%), while 78% of workers not working downtown got to work by car. While 40% of downtown workers took public transit to work, only 12% of those not working downtown took public transit to work. The responses indicate that about two-thirds of all transit trips to work are trips to downtown.

Auto dependence for those not working downtown was greatest in the three Prairie cities, where the proportion of those getting to work by car ranged from 81% in Winnipeg to 85% in Edmonton and 86% in Calgary. Noteworthy, however, was the fact that 79% of both Montrealers and Vancouverites not working downtown got to work by car.

Toronto apparently continues to live up to its reputation of having one of North America's best and most-used public transit systems. Public transit use is further boosted as a result of the very high proportion of workers indicating that they worked downtown. Only much smaller Halifax had a larger proportion of jobs located downtown–46% in Halifax and 45% in Toronto.[5] Only 38% of those working downtown got there by car, while 53% came by public transit.

Montrealers also have access to a relatively comprehensive, underground public transit system, but public transit usage is considerably lower than in the case of Toronto for two reasons. First, only 30% of respondents said that they worked downtown. With 25%, only Edmonton had a smaller proportion. Secondly, those Montrealers not working downtown, 79% of whom got to work by car, are nearly as auto-dependent as their colleagues elsewhere in Canada. For those working downtown, trip to work mode resembled that for Toronto.

Disaggregation of responses by place of residence, as well as place of work, reveals much about the trip to work modal choices of large-city Canadians and the dynamics of travel to work in Canadian cities. For those both living and working downtown, the most common mode of travel (38%) was walking or cycling, ranging from 32% in Toronto to 61% in Ottawa. Most of those responding that they lived in the downtown centre also worked downtown (64%). Those not working downtown, like most other workers, said that they got to work by car (63% for those living downtown, compared to an overall average of 78% for all individuals not working downtown).

Those respondents characterizing their residence as elsewhere in the old inner city were also much more likely to walk or cycle to work than the average (19%), ranging from 14% for Toronto to 36% for Calgary and Winnipeg, if they worked downtown (46% versus 37% for all respondents). Public transit was the most common mode (42%), ranging from 24% for Ottawa to 48% for Edmonton. Thirty-eight percent of downtown workers said that they got to work by car, ranging from 21% for Winnipeg to 52% for Edmonton.

Those living in areas they characterized as older suburbs exhibited transportation mode behaviours very similar to the average, including the fact that trips to work were much more frequently by public transit (44%) for those working downtown (38%). For the 62% working elsewhere than downtown 77% got to work by car and 14% by public transit.

While those respondents living in new suburbs and working downtown (29%) were less likely to get to work by car (64%) than those working elsewhere (87%), the difficulty of providing adequate public transit service for so few users is evident. Even in Toronto, only 26% of respondents indicated that they worked downtown, and the average (weighted) for the eight cities was 29%. About 10% of all transit trips to work are from new suburbs to downtown.

Satisfaction with Public Transit by Use and Location of Residence

The provision of public transit is not generally rated by large-city Canadians as the best service of their municipalities. Far from it! About 20% of respondents were dissatisfied with transit service, while fewer than 12% were dissatisfied with the overall level of municipal services, and 32, 30 and

Table 4

TRANSIT SATISFACTION BY AREA OF RESIDENCE AND USE

Dissatisfied	All %	Van %	Cal %	Edm %	Wpg %	Tor %	Ott %	Mtl %	Hfx %
Area of Residence									
Downtown Centre	21	21	12	19	11	20	28	28	13
Inner City	19	25	16	22	13	22	23	15	8
Older Suburb	18	29	14	11	11	16	22	16	17
New Suburb	23	30	15	17	16	20	23	29	24
Total (Workers)	20	28	15	15	14	18	23	21	18
Transport to Work									
Car	23	30	17	12	16	22	28	27	18
Public Transit	18	34	14	23	10	17	19	11	19
Walk/Cycle	21	25	15	21	23	21	22	16	16

Source: Angus Reid Group, *Urban Canada Study, 1991*, IUS tabulations

25% were dissatisfied with street maintenance, welfare and social services and snow removal, respectively. It was reported in Issue No. 1 that the proportion dissatisfied by city ranged from a low of 14% in Winnipeg to a high of 30% in Vancouver. Levels of satisfaction and dissatisfaction by area of residence and usual mode of travel to work were reviewed for this issue (Table 4).

Transit users were generally slightly less often dissatisfied than car users (18% vs. 23%), although this order did not hold for either Edmonton or Vancouver. Winnipeg appears to have the most satisfied users, as only 10% were dissatisfied. By comparison, 34% and 23%, respectively, of transit users in Vancouver and Edmonton were dissatisfied.

While those living in new suburbs tended to be more dissatisfied with transit service than those living in other parts of Canada's large cities, they were only marginally so. Residents of the old inner city and older suburbs were generally least dissatisfied with municipal transit services.

Conclusion

The responses to the Urban Canada Study, 1991, confirm much of what at least a minority of Canadian planners have understood for some years. Public transit is not the service which Canadian municipalities perform best. They are considerably better in the minds of large-city Canadians at providing fire protection, parks and recreation services and public libraries.

The use of environmentally more friendly modes of travel to work, walking/cycling or use of public transit, depends very much, first, on where one works. Downtown workers are much more frequent users of public transit. Second, proximity of home and work appear to be among the most important factors in deciding to walk or cycle to work. Workers living and working in the downtown centre are the most likely to walk or cycle to work. Those living in the older inner city are also much more likely to walk or cycle to work. Respondents living in new suburbs possess a much lower tendency to take public transit to work, even when the destination is downtown with its attendant traffic congestion and high parking fees, and they hardly ever walk or cycle to work.

The implications of these tendencies for the design of our cities are profound. Higher densities and greater proximity of home, and work, given constant supply characteristics of different transit modes are required if the choice of mode of travel to work is to become more environmentally friendly or healthier. Of course, it is assumed that altered supply characteristics, more expensive fuel for cars, more expensive parking or less of it, improved and/or cheaper public transit service, and sole-use bicycle paths or lanes would influence choice of mode of travel to work. The data from the Angus Reid Group study do not permit the testing of these parameters.

Notes

1. Statistics Canada, *National Urban Air Quality Trends: 1978-1987* (Report EPS 7/UP/3, May 1990).

2. Ibid., Table 9.

3. House of Commons, *Out of Balance: The Risks of Irreversible Climate Change* (Ottawa, March 1991, Table F).

4. Richard Gilbert, *Activities Related to the Prevention of Climatic Change in Some Major Urban Areas of North America* (Toronto: Canadian Urban Institute, 1991).

5. Note: In addition to sampling error, as well as differences that may be introduced as a result of respondent definitions, proportions may vary from those found in other studies as a result of variations in the definitions of geographic units.

Jeffrey Patterson
Senior Research Fellow

Car Dependence: Costs, Causes and Cures

2nd International Conference on Auto-Free Cities

May 22-24, 1992, University of Toronto, Canada

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The automobile: in less than a century it has become one of our most complex cultural symbols and one of our least sustainable physical and psychological dependencies.

We are coming to realize why the car is not sustainable: global warming, increasing bronchial diseases, noise, congestion, road kill, inefficient land use patterns . . . That's why community workers, politicians, industrialists and environmentalists are grappling with questions like: "How did we get ourselves into this mess?" and "Where do we go from here?"

The Second International Conference on Auto-Free Cities will bring together researchers, business people, grassroots activists, transportation engineers, architects and auto-free visionaries to seek and share local and global paths to car reduction. It will include practical plans as well as inspirational visions of a car-free world. Topics will range from the economics of car use, to land-use planning, to architecture for a car-free world, to business opportunities in a car-free world, to transportation systems planning, to auto-free art, to the role of the car as a cultural icon, to visual presentations of auto reduction successes in other cities. . . . Toronto's costs, causes and cures will be the focus of the final day.

Contact: Transportation Options, 427 Bloor Street W., Suite 205, Toronto, Ontario, Canada M5S 1X7. Voice or fax (416) 960-0026. Conference coordinator: Victoria Armstrong.

In justice:
Canada, Minorities and Human Rights

Simon Fraser University at Harbour Centre
Vancouver, British Columbia
April 30-May 2, 1991

Sponsored by the National Association of Japanese Canadians, and the Centre for Canadian Studies, Simon Fraser University with the support of the Japanese Canadian Redress Foundation.

During times of national crisis, governments have historically focused on specific minority groups as one aspect of maintaining the security of Canada. A number of affected ethnic minority groups have expressed a strong need to reclaim their history by seeing the injustices of the past acknowledged and to work toward positive legislative and policy safeguards to prevent future injustices. Governments and agencies meanwhile struggle to find ways of avoiding repetitions of the past. This national conference addresses: past treatment of minorities during national crisis; the use and abuse of emergency laws and powers, and the impact on the human rights of minority groups; proposals for legislative and operational safeguards to maintain the rights of minority Canadians during periods of national crisis. This conference also celebrates the rich body of literature, drama and poetry based on personal experiences.

Contact: Public Policy Programs, Continuing Studies, Simon Fraser University, Burnaby, BC V5A 1S6.
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SUSTAINABLE CITIES

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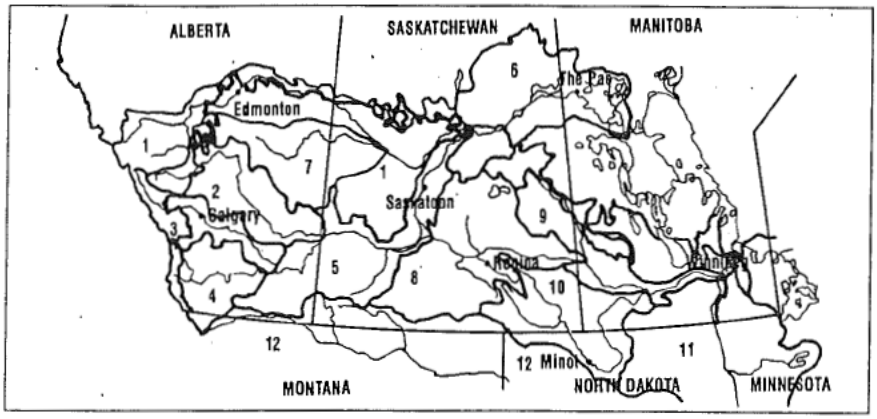
URBAN STREAM DEGRADATION: FIVE PRAIRIE CITIES

Jeffrey Patterson
Senior Research Fellow
Institute of Urban Studies

Research being undertaken at the Institute of Urban Studies as part of its research related to sustainable urban development has as its objective the investigation of ways and means of improving the quality of the urban environment and of urban living for this and future generations. The focus of this research is the primary urban areas in Canada's Prairie region, which Canada's State of the Environment Report *labels "one of the most endangered natural habitats in Canada." The ecology of the Prairie grasslands region renders its streams and rivers one of the most vulnerable subsystems of the larger ecosystem. The focus of this issue of* Sustainable Cities *is degradation of surface water quality in and around the five primary urban centres: Calgary, Edmonton, Regina, Saskatoon and Winnipeg.*

River basins within the prairie grasslands region



1 North Saskatchewan	4 Oldman	7 Battle	10 Souris
2 Red Deer	5 South Saskatchewan	8 Qu'Appelle	11 Red
3 Bow	6 Saskatchewan	9 Assiniboine	12 Missouri

Prairie grasslands region — River basin

Source: Environment Canada, Inland Waters Directorate, Western and Northern Region, Regina.

Prairie Cities and the Prairie Ecozone

Grasslands occur where the climate is too arid for forest development, yet suitable for dense growth of smaller plants. Canada's Prairie grasslands, an extension of a larger ecozone occupying much of the centre of the North American continent and bounded on the West by the Rocky Mountains, on the North by boreal plains, on the East by boreal shield and on the South by the international frontier and the main body of the continental grasslands, occupy about 500,000 km^2, 27% of the provinces of Alberta, Saskatchewan and Manitoba and 5% of Canada's total area.

In 1986, almost 87% (45.4 million ha) of the Prairie grassland's total 52.2 million hectares was in farmland, and this farmland accounted for over 82% of the total farmland in the three Prairie provinces and 67% of total farmland in Canada.[1] In 1991, the ecozone was also home to over 86% (4 million) of the Prairie provinces' 4.6 million people.

Despite the traditional rural resource and population base, the Prairie grasslands have also become predominately urban, and urban areas continue to grow in population even while rural population decreases. The five census metropolitan areas (CMAs) contained over 2.6 million people in 1991, 66% of the Prairie grassland total and 5% more than for Canada as a whole. The 1991 census shows an 8% growth in the population of the five CMAs from 1986 and a decrease of 3,000 population in the remainder of the three provinces.

Water Resources and Resource Use

Shielded by the Rocky Mountains from water-producing winds from the Pacific, the Prairie grasslands are characterized by a climate that is semiarid, with short, hot summers, long, cold winters, low levels of precipitation and high evaporation. Total average precipitation for the five cities ranges from a low of 349 mm for Saskatoon to a high of 526 mm for Winnipeg, and the average for the five cities (430 mm) is slightly less than half of that for the five main cities in the Windsor-Quebec corridor of central Canada (875 mm) and slightly over 30% of that received by the four capital cities of the Atlantic provinces (1,404 mm).[2]

The Prairie grasslands are essentially drained by two river systems, the

Saskatchewan with a total Canadian drainage area of 405,000 km^2 and the Red with a total Canadian drainage area of 186,000 km^2, and the five primary cities are located on streams in these basins. Both rivers flow into Lake Winnipeg, which drains into Hudson's Bay by way of the Nelson River. Owing to their different origins, the rivers of the two basins possess somewhat different characteristics. The headwaters of the Bow and the Oldman, which converge to form the South Saskatchewan, and the North Saskatchewan, rise in the eastern slopes of the Rocky Mountains, which contribute about 70% of the mean annual flow at The Pas, Manitoba. Only 7% is contributed by the grasslands region in Saskatchewan and Alberta.[3] The combination of low rain and snow fall, high evaporation and rolling, poorly drained land results in very low runoff from the Prairie grasslands. The Red River basin drains an area of approximately 126,000 km^2 in Saskatchewan, over 40% of the basin total, but Saskatchewan waters contribute only 9% of the total flow in the Red River at Lockport near Lake Winnipeg.[4] All told and despite their total drainage basins of over 715,000 km^2, the Red and North and South Saskatchewan Rivers contribute less than 30% of the waters received by Lake Winnipeg and less than 2% of total flows into Hudson's Bay.

The characteristics of the soils and agricultural activity in the Prairie grasslands critically affect surface water quality even in the absence of further degradation as the streams flow through the primary Prairie urban centres. Waters originating in or flowing across the Prairies pick up large quantities of nutrients, metals, minerals, salts and sediments relative to waters in mountains. Nutrients such as nitrogen and phosphorus are naturally abundant in Prairie soils and naturally lead to eutrophication of lakes and even the rivers themselves, characterized by the growth of macrophytes (aquatic weeds), odours, cloudy water and oxygen depletion. In addition to transforming the Prairie grasslands by placing about two thirds of them into cropland and summer fallow area, humans have applied ever more nutrients to Prairie soils. Between 1971 and 1986, the application of nitrogen from animal and commercial fertilizer increased by almost 200% to 1,082,000

TABLE 1: STREAM FLOW AND 1981 AND PROJECTED 2011 WATER WITHDRAWAL AND CONSUMPTION

	BASIN				
	Assiniboine Red	North Saskatchewan	South Saskatchewan	3 Prairie Basins	Total Canada
Flow (millions m^3/yr)					
Reliable (Low: 19yr/20)	497	5,046	4,636	10,179	2,392,186
Mean	1,553	7,380	7,537	16,470	3,315,525
Withdrawal (millions m^3/yr)					
Municipal	155	132	264	838	4,263
Rural Residential	21	17	20	58	347
Agriculture	188	94	1,963	2,245	3,125
Mining	14	55	8	77	648
Manufacturing	24	90	121	235	10,201
Thermal Electric	610	1,018	202	1,830	19,281
Total	1,012	1,405	2,578	4,995	37,864
Consumption	207	154	1,680	2,041	3,906
% of Flow	41.6	3.0	36.2	20.0	0.2
Est. 2011 Withdrawals					
Low	1,354	2,041	2,601	5,996	47,738
High	2,284	3,267	6,058	11,609	84,039

Source: P.H. Pearce *et al., Components of Change*, Final Report, Inquiry on Federal Water Policy, September 1985. Ottawa: Environment Canada, Tables 3.2, 4.1, 4.6.

tonnes, and the application of phosphorus increased by almost 150% to 563,000 tonnes.[5] Animal manures supplied 66% of the total in 1971, but had decreased to 22% by 1986. The quality of Prairie streams is also adversely affected by the increasing use of insecticides. Between 1970 and 1985, constant dollar expenditures per hectare of cropland increased by 856%. It may be fortunate that runoff on the Prairies is low. A portion of the added nutrients does nevertheless find its way into Prairie streams.

Prairie grasslands water systems have been extensively modified and intensively developed. Virtually every major river has been dammed to provide water during drought and to prevent flooding during peak flows. Twenty-one dams have been built in the Saskatchewan and Red River systems. In addition to spreading flows out over a longer period of time and providing more secure supplies of water, the dams may also be beneficial to the extent that they trap sediments, increasing the clarity of streams, and oxygenate waters flowing over them. There are also some harmful effects. Dams also trap contaminated sediments, and evaporation from Prairie reservoirs represents 23% of the total consumption of an increasingly scarce resource.[6] As well, it is estimated that 110,000 of the 149,000 farms on the Prairies have dugouts to capture spring runoff before it flows into larger streams. In dry years many of these dugouts are filled by water pumped from lakes and streams.

Water use for agriculture has the greatest effect on the overall water resources of the Prairie grasslands. Agriculture can be practised in parts of the Prairies only because of irrigation. While only 2.4% of farmland is irrigated, irrigation accounts for 46% of all water withdrawal and 85% of total water consumption on the Prairie.[7] Table 1 summarizes water withdrawal and consumption for the three main river basins of the Prairies. Mostly as a result of agricultural use, the Prairies account for 52% of Canada's total water consumption, although Prairie rivers account for only 0.4% of reliable Canadian stream flows. Consumption accounts for 20% of reliable flows throughout the Prairies: 36% in the South Saskatchewan basin; only 3% in the North Saskatchewan basin; and a high of 42% in the Assiniboine-Red basin. While consumption in the Red River basin is only 10% of the Prairie total, the ratio of consumption to flows is so high because the basin contains only 5% of total reliable flows in the Prairie grassland region.

Prairie cities appear to be fairly typical of other Canadian municipalities. While their population comprised about 18% of that served by Canadian municipal water utilities in 1981, they took about 20% of total water withdrawn by municipalities in Canada.[8]

Prairie Cities and Water Resources and Uses

The five primary cities (Edmonton, Calgary, Regina, Saskatoon and Winnipeg) exist in an ecologically fragile region. While the main stress in the region is undoubtedly the nearly total dedication of the Prairie grasslands to farmland and farming practices, the Prairie cities comprise the second most critical stress on the resources of the region, and the main resources upon which stress is placed the same water resources that are also burdened by agricultural practices and consumption for farm irrigation.

Municipalities adversely affect the quality of river waters principally with their wastewater effluent and almost universally untreated runoff. The collection and treatment of wastewater begins with the connection of toilets and other wastewater generators to municipal sewer systems. Toilet water, often characterized as "blackwater" by municipal engineers, accounts for one third of total domestic wastewater, one half of organic solids, 75% of nitrogen, 20% of phosphorus and all of the faecal coliforms in wastewater. The other two thirds of domestic discharge is usually characterized as "grey water." Again, owing in part to the fragility of the Prairie grassland ecosystem, municipal sewer systems in the Prairies tend to serve larger proportions of urban residents than in other parts of Canada, ranging from 95% in Manitoba to over 99% in both Saskatchewan and Alberta. The Canadian average in 1982 was 85%.[9] Sewage effluent contributes nutrients that add to the natural eutrophication process that is already intensified as a result of the application of animal and commercial fertilizers and insecticides for agricultural purposes. Sewage effluent can also cause the bacteriological quality of surface waters to deteriorate and adversely affect their recreation potential.

Effluent from local sewers generally flows to a sewage treatment plant or pollution control centres (PCCs) through interceptor sewers. The proportion of dwellings served by sewers also served by PCCs in the Prairie provinces ranges from 99.7% in Manitoba to 100% in both Saskatchewan and Alberta, although it was only 67% for all of Canada in 1982.[10]

Municipal sewage treatment systems vary considerably in the extent to which they treat effluent, characterized as primary, secondary and tertiary treatment. Tertiary treatment involves the removal or neutralization of microbiological organisms and the removal of nutrients from sewage treatment. Between 1983 and 1989, the proportion of population served by tertiary treatment facilities in the Prairie grassland's 12 census agglomerations increased from 8% to 32%.[11] The Environmental Protection Agency (EPA) in the U.S.A. now requires that all sewage effluent be subjected to tertiary treatment, and the meeting of this requirement by the North Dakota cities of Fargo and Grand Forks has been instrumental in upgrading the quality of the Red River entering Manitoba at Emerson to generally acceptable levels. As well, and as part of a commitment to improve water quality in the Great Lakes by both the U.S.A. and Canada, Ontario now requires municipalities on the Great Lakes to subject sewage effluent to tertiary treatment.

In addition to the quantity, which usually varies by size of city, and quality of sewage effluent, society's concern for the need for a response to adverse quality of wastewater and stormwater effluent will be tempered by the impact of the effluent on the receiving waters, which depends in part on their quantity and flow, and by the use which society makes or wishes to make of those receiveing waters.

Underlying the principle of sustainable development is the notion that decision-making, including urban planning, should simultaneously consider the ecosystem and the economy and their relationship to one another. Economic development projects and programs should not be undertaken if their environmental impact is significant. Although this principle does not contain formulae for undertaking the necessary accounting calculations, a benefit/cost calculus is nevertheless implied. Also implied in the case of effluent mitigation decisions is the notion that the current and future uses of the receiving bodies of water are a factor in any decisions.

Water quality control in Canada generally lies within provincial jurisdiction. The traditional response of Canadian provinces, a response that is shared with most other jurisdictions, has been to regulate the quality of sewage effluent. The object of this regulation has generally been to seek the highest quality possible, although the speed with which provinces have required municipalities to meet this objective has often been tempered by the cost and fiscal burden on municipalities.

This approach is typified by the EPA in the U.S.A. The EPA's overall objective has been the achievement of zero contaminated discharge of sewage effluent by municipalities. By imposing a stan-

TABLE 2: HISTORY OF SEWAGE TREATMENT IN PRAIRIE CITIES, 1900-1990

	PRIMARY	SECONDARY	TERTIARY		
			Nutrient Reduction	Ammonia Reduction	Microbiological Disinfection
Calgary	1931	1968	1981-83	1981-83	1981-83
Edmonton	—	1916	Planned	Planned	Planned
Regina	1900	1914	1974	1974	1974
Saskatoon	1945	Planned	1983	X	1983
Winnipeg	1939	1966	X	X	X

X indicates no planned deadline.

Sources: Environment Canada, *The State of Canada's Environment*, 1991, Figure 17.13; and Charles S. Conyette, *A Review of Wastewater Treatment Systems, Processes and Water Industry Management Plans: Their Potential Application to the Red and Assiniboine Rivers*, 1991. Winnipeg: Manitoba Environment, p. 26.

dard of 200 faecal coliforms/100 mL of water as measured in the receiving body of water, the EPA implicitly allows for the quality of effluent to vary according to the volume of receiving water. The EPA's approach and standard are based on the notion that no municipality should have to receive contaminated waters as a result of the actions of another user.

In the Prairies, the provinces of Alberta and Saskatchewan have generally applied the EPA standards and methods, but have generally relied on negotiation to obtain compliance from municipalities, certainly the larger ones. The waters of both provinces are regulated by standards of the Prairie Water Resources Board (PWRB) as those waters traverse provincial boundaries. Both provinces and the PWRB now use the EPA standards, although there is some concern that the standard for faecal coliforms is not stringent enough, especially given the knowledge that a standard of 100 FC/100 mL is applied in the European Economic Community. There are very few studies of the actual risk associated with body contact with waters of various qualities (none of which this author is aware in Canada), and the EPA standard accepts the notion that some risk is tolerable by society and that the benefits of treating sewage effluent beyond a certain standard likely do not justify the costs.

Manitoba followed the same approach, but deviated in a major way in 1987. Beginning in 1990, municipalities, including Winnipeg, have been required to apply to the Clean Environment Commission for licences to release effluent into the province's streams. Following public hearings, the Commission makes recommendations to the Minister of the Environment, and the Minister makes the decision regarding the granting of the licence and/or any conditions that may be imposed. In deciding precisely what to recommend to the minister, the Commission is required to consider the uses of the receiving waters. While the EPA standard is accepted for waters that will be used for primary (body contact) recreation, Manitoba Environment has developed other standards for waters having other uses: domestic consumption; aquatic life and wildlife (2 classes); industrial consumption; agricultural consumption (3 classes); and secondary recreation.[12] While practices in Alberta and Saskatchewan are also subject to regulation by the PWRB, Manitoba's practices are not as influenced by the Board. Manitoba waters seldom flow to another jurisdiction.

Table 2 indicates the history of sewage treatment practices and current plans for the five primary Prairie cities.

A major persistent source of river contamination in two of the primary Prairie cities–Edmonton and Winnipeg–is the extent of combined sewers in the older parts of the cities. Standard practice prior to the 1950s in most parts of Canada was not to build separate sewer systems for wastewater and stormwater. These older areas are consequently served by "combined" sewers, and retrofitting was required to direct the effluent in them to sewage treatment plants as treatment became the new norm. Retrofitted interceptor sewers that directed effluent to PCCs were usually designed to accommodate a specific multiple of effluent most of the time (2.75x for Winnipeg), but it was usually decided that the cost of designing a treatment system that would handle all flows even during major rains and storms would be prohibitive, certainly relative to the benefits received. Consequently, these interceptor sewers are usually designed to accommodate a multiple of what is termed "dry water flow" (DWF). During wet periods, only a portion of the effluent is directed to treatment plants. The remainder of wet water flow (WWF) is allowed to "overflow" the interceptors directly into rivers.

Approximately 52% of the population of Winnipeg is served by combined sewers. A much smaller, but significant proportion is served by combined sewers in Edmonton, while 5% of the population of Regina continues to be served by combined sewers.[13] Neither Calgary nor Saskatoon have areas that continue to be served by combined sewers. It is estimated that one result of the 30-50 wet water events that occur annually in Winnipeg is that approximately 45% of all wastewater and 65% of all blackwater receives no treatment whatsoever, and in the absence of other mitigating actions, would continue to escape treatment in any upgraded treatment facilities.[14] Other cities with large areas still served by combined sewers are making plans for their gradual replacement. Both Ottawa and Vancouver, where 15% and 19% respectively of the population are served by combined sewers, plan to replace 1% annually. Other major Central and Eastern Canadian cities have problems stemming from combined sewers on a scale similar to that observed in Winnipeg.

River Characteristics of the Five Cities

Table 3 summarizes historical and current flow data for the five primary Prairie cities, including reliable (level exceeded 19 of 20 years) and average flows historically and for the decade of the 1980s. The data show the greater dependability of flows in cities in Alberta near headwaters in the Rocky Mountains. Reliable flows are approximately 80% of average flows for both the short and long term. Summer flows, critical in the case of recreation use, are also higher relative to average flows in the basins of the North and South Saskatchewan Rivers, reflecting mountain snow and ice melt in June and July. Each of the five cities experienced decreased stream flows in the 1980s. These decreases have had their largest impact on the downstream cities.

River Uses and Human Impact in the Five Cities

As was indicated above, there is some lack of consistency in the approaches of the three Prairie provinces regarding the standards that should be applied and the requirements to make sending waters as free of contamination as waters received that should be imposed on municipalities.[15] Table 4 summarizes the impact of the five primary Prairie cities on the streams that flow through them.

While the practice with respect to treatment of sewage effluent is critical to the quality of water sent to communities downstream from these primary cities, the characteristics of the sewer system itself are also critical. For instance, current practice is to build two sewer/drainage systems in urban areas, one for wastewater and the other for stormwater. Current practice is not to treat stormwater, although more recent analysis has found that stormwater is often a major source of surface water contamination, especially of heavy metals. The EPA in the U.S.A. now requires treatment of stormwater. Since the early 1960s, partly motivated by the desire to reduce servicing costs, Prairie cities have increasingly relied on stormwater retention ponds to reduce contamination from this source.

Calgary. The Bow River, which is joined by the Elbow at Calgary, is the second smallest of the streams serving the five cities. However, its location near the Rocky Mountain headwaters near Lake Louise has provided the city with a reliable flow of pristine waters equal to about 80% of annual average flows. Flows through Calgary have also been regulated since 1913. While flows decreased in the 1980s, they still remained at over 90% of their historical levels, and reliable flow seems to have been unaffected. Average summer flows are about twice the annual average.

Notwithstanding that sewage treatment was not commenced at all until during the 1930s, the impact of Calgary on the quality of water in the Bow River has always been of concern to both Calgarians and Albertans. This concern likely explains the considerable efforts that resulted in the completion of tertiary treatment facilities in the 1980s. Calgary is not affected by combined sewers.

Surveys undertaken in the late 1980s showed that over 111,000 people, 91% of them Calgarians, participated in water-based recreation on an annual basis and that another 185,000 people participated in land-based recreation in parks adjacent to the Bow River, most frequently walking, jogging and biking. The value of recreation benefits was estimated at almost $12 million in 1987.[16] Fishing was the most common form of water-based recreation, and almost one fourth of benefits resulted from spending by guided anglers in the Bow's cold waters, half from elsewhere in Alberta and half from the United States and elsewhere in Canada. Water-based recreation, as well as the popularity of land-based recreation in the parks near the Bow likely contributed to Calgary's current plan for its river valleys.[17] Three provincial parks adjoin the Bow in or below Calgary.

TABLE 3: STREAM FLOW DATA FOR FIVE PRAIRIE CITIES FLOWS (M^3/S)

	ANNUAL					
	Long-Term		1981-1990		Low Month	Summer Avg.
	Reliable[1]	ñ	Reliable[2]	ñ		
Calgary (Bow)	66	91	67	84	44	184
Edmonton (North Saskatchewan)	148	214	167	205	58	471
Regina (Wascana Creek)						
Saskatoon (South Saskatchewan)[3]	71	187	65	122	42[4]	370
Winnipeg (Red)[5]	63	205	60	162	46	214

[1] Low: 19/20 yrs.
[2] Low.
[3] Estimated uncontrolled.
[4] Regulated.
[5] Lockport. Assumes historical flows across border at Emerson, Manitoba, and in Assiniboine River.
Source: Environment Canada, *Historical Streamflow Summary: Alberta; Manitoba; Saskatchewan.*

TABLE 4: BIOLOGICAL, NUTRIENT AND SURFACE WATER CHARACTERISTICS, PRAIRIE CITIES AND RIVERS

City/River/Location	Annual Averages (per L or 100 ml)							
	Dissolved Oxygen (08102F)[1]	Turbidity (02073L)[1] (NTU)	Total Coliforms (36001L)[1]	Fecal Coliforms (36011L)[1]	Ammonia (506L05L)[1]	Total Nitrogen (7602)[1]	Dissolved Phosphorus (15103L03F)[1]	Flow (M^3/S)
1. Calgary/Bow River								
A. 1980-1982								
1. Bowness (Western city boundary)	na	na	109	33	<.01	.05	.004	92
2. Stier's Ranch (Southeastern city bound.)	na	na	<2400	<2400	.36	1.19	.169	na
3. Carseland Dam	na	na	<2400	1760	.45	.82	.147	185[2]
B. 1983-1988 (After Facility Upgrading)								
1. Bowness	11.3[3]	na	14	2	.09	.282	.003	71
2. Stier's Ranch	12.0	na	5400	520	.66	1.420	.018	na
3. Carseland Dam	11.3	na	700	113	.28	1.270	.020	79
2. Edmonton/North Saskatchewan River								
A. 1970-1977								
1. Waskatenau Bridge	na	na	5512	1547	na	na	na	192
B. 1985-1989								
1. Devon (West of Edmonton)	10.0	12.5	272	5	.006	.18	.004	na
2. .5 km above Sturgeon River	7.7	na	na	3683	na	na	na	196
3. Waskatenau Bridge	9.9	15.0	7647	3580	.17	1.10	.059	na
4. Pakan Bridge	9.9	6.0	na	382	na	1.13	.068	na
5. Lea Park	10.5	16.6	4371	172	.08	.825	.054	na
3. Regina/Wascana Cr./Qu'Appelle River								
A. 1991-1992								
1. Wascana Cr./Albert Street	8.0	7.2	20	20	na	na	.43	na
2. Wascana Cr. above Qu'Appelle River	5.5	12.4	161	115	.08	.42	.46	2
3. Qu'Appelle Cr. above Wascana Cr.	8.6	8.7	52	27	.04	.20	.27	na
4. Qu'Appelle River/Lumsden	7.7	13.0	70	41	.12	.38	.30	na
5. Qu'Appelle River/Pasqua Lake	8.0	5.5	8	14	.12	na	.22	na
4. Winnipeg/Red River								
A. 1983								
1. Emerson	9.7	72.4	18	5	.14	.43	.12	123
2. South Floodway	na	72.9	na	35	.109	na	.34	na
3. North Perimeter	na	52.2	na	7493	.080	na	.32	na
4. Lockport	na	41.7	na	1720	.105	na	.27	225
B. 1987-1989								
1. South Floodway	na	39.9	na	46	.105	6.56	.24	na
2. North Perimeter	na	32.1	na	9296	.336	2.41	.37	na
3. Lockport	na	27.4	na	3061	.332	2.30	.33	118

NOTES:
1. NAQUADAT Code
2. 1981 only
3. 1985 only

SOURCES:
1. A.J. Posiak An Evaluation of Nutrients and Biological Conditions in the Bow River, 1936-1988.
2. Alberta Environment, Water Quality Data, 1985-1989 Synoptic Services.
3. City of Regina, Public Works Department.
4. Manitoba Environment.

Primary concern with respect to river water quality has been aimed at the growth of macrophytes downstream from Calgary and their interference with both agricultural and recreational use. Studies in the 1970s had shown that the presence of dissolved nutrients in the Bow River below Calgary were almost entirely biological in nature and emitted by Calgary's two PCCs. A total of $117 million ($167 million in $1991 constant), $32 million of it allotted to the installation of phosphorus removal facilities, was invested in treatment upgrading in the early 1980s. Table 4 shows that the presence of dissolved phosphorus and nitrogen in Bow River samples some 23 km downstream from Calgary's eastern boundary decreased by 85% and 23% respectively in the three years following the upgrading of treatment. Concerns

regarding the microbiological quality of the Bow River remain. Depending on river flows, data indicate that annual average concentrations of coliforms and faecal coliforms may be considerably above Alberta Environment's standards and about equal to those for secondary recreation for Manitoba Environment at the sampling site. Sites further from Calgary generally evidence acceptable levels.

Edmonton. The North Saskatchewan River at Edmonton is the largest of the five streams flowing through a major urban centre, and it appears to have experienced the smallest decrease in flows during the 1980s. Reliable flows are almost 80% of average flows, and average summer flows are about 2.2 times average flows of 214 m^3/s.

While located a considerably further distance from its headwaters than is Calgary, the North Saskatchewan River is of nearly pristine quality as it reaches Edmonton, and it is these waters from which the city draws its fresh water supplies. Degradation of surface water quality downstream of Edmonton occurs almost entirely as a result of contamination as the North Saskatchewan flows through Edmonton. As can be seen in Table 4, the river picks up considerable loadings of nutrients and faecal coliforms in Edmonton and these remain at the monitoring station at Pakan. The annual average number of faecal coliforms was far above provincial standards in the early 1980s, although below numbers recorded in the 1970s. Monthly data indicate that this may also be the case in one or more summer months, although concentrations are less than average in summer as a result of mountain snow and ice melt. While Alberta Environment no longer maintains monitoring stations closer to Edmonton, data for the monitoring station at Waskatenau during the 1970s indicate that concentrations may easily be five times as great as at Pakan immediately downstream from Edmonton.

Edmonton initiated secondary treatment processes in 1916 and has since made only marginal improvements to its sewage treatment capability. The volume of water in the North Saskatchewan–about twice that of the Bow–has likely made it possible for both the city and the province not to consider the situation critical. Lower demand for recreational use may also be a factor. As well, earlier data indicate that the situation was not worsening and may have been improving. However, facilities for nutrient and ammonia reduction and for microbiological disinfection are now planned for completion by 1998 at a cost of $55 million. Alberta Environment may also require that Edmonton begin treating stormwater and reduce or eliminate overflows from combined sewers.

Regina. Drainage, especially the presence of a stream in which to flow waste effluent, was not a consideration in the choice of a site for Saskatchewan's capital city. Nor has squandering water resources ever been a luxury that could be tolerated even for a few years. As well, the Qu'Appelle River into which the city's only stream, Wascana Creek, flows a short distance downstream is both a major provincial recreational resource and a typical river of Prairie origins, already prone to eutrophication and with a relatively small volume of water. Consequently, Regina was the first Prairie city to undertake even primary sewage treatment, and in the mid-1970s it was also the first to complete tertiary treatment facilities. The city continues to be concerned with the quality of effluent, and there are plans for still further improvement in the city's sewage treatment facilities that are projected to cost $70 million.

Saskatoon. The South Saskatchewan River at Saskatoon evidences considerable annual variation in flow with reliable flows less than half the average. It also had the largest decrease in flow in the 1980s: 35%. Low flow was over 10% less than during the dry years of the 1930s. The South Saskatchewan is formed in Southern Alberta by the confluence of the Bow and Oldman Rivers, and it is these that have been used extensively to irrigate farmland. Further decreases as a result of irrigation are anticipated in the future, although for the time being, summer flows continue to approximate twice the annual average.

Saskatoon had intended to emulate Regina in commencing sewage treatment prior to World War I, but events transpired in such a way that the city was not motivated to construct its first sewage lagoons until the downstream municipality of Cory obtained a court injunction against dumping raw effluent into the river during World War II. In 1945, Saskatoon became the last of the five cities to initiate primary treatment. The primary treatment plant, still in operation, was opened in 1971. It is also equipped with a microbiological disinfection process, and limited nutrient removal processes were added in the early 1980s. Secondary treatment processes are planned, and anticipated to be in place by 1995 at a capital cost of $40 million.

Winnipeg. While the Red River at Winnipeg has the largest geographical basin of any of the five streams, its extreme variability and reliable flow–less than a third of average flows–of 60 m^3/s makes it the smallest of the four rivers. The Red has been less affected by irrigation uses than the South Saskatchewan, but this may not always be the case. Flows from the Souris River, already 40% less than the historic average during the 1980s, are expected to decrease further as a result of construction of the Rafferty and Alameda dams in Saskatchewan. The Manitoba government is currently considering proposals to divert 6% of the flows in the Assiniboine River to dry areas in the Southwestern part of the province. As well, about 45% of the total flow below Winnipeg comes from the U.S.A., and treaty rights would allow this to be reduced by half, or 23% of historic flows. Reliable flows under Canadian control are probably 25% less than those actually experienced. Because Prairie thaws occur earlier than those in the mountains, summer flows in the Red River approximate the annual average.

As can be seen in Table 4, while the Red River is relatively saturated with nutrients as it enters Canada from the U.S.A., it is relatively free of microbiological organisms, considerable progress having been made with effluent treatment in North Dakota municipalities in the 1970s and 1980s. Considerable further nutrient loading occurs as a result of effluent flowing from Winnipeg, and the concentration of faecal coliforms originating in Winnipeg makes the Red River below Winnipeg the most degraded in the Prairie grasslands region. While the Red is the source of only 6% of the total water flowing into Lake Winnipeg, it is believed to be the source of 59% of the dissolved phosphorus and 33% of its dissolved nitrogen.[18] Concern about the impact of sewage effluent from Winnipeg on this important tourist resort and cottage area has been expressed. Faecal coliform numbers emanating from Winnipeg effluent are greater than in any similar body of water in the Prairie region, and they increased by almost 80% from 1983 to 1987-89, undoubtedly due in part to an almost 50% decrease in average annual flow in the late 1980s.

The demand for recreational use of the Red River is relatively intense. Boating and water skiing are common, and the number of boat and shore anglers–over 60,000 annually, especially in the stretch between Lockport, 20 km downstream from Winnipeg, and Lake Winnipeg–makes recreation on the Red almost as valuable to Manitobans as the Bow is to Albertans.[19] In addition, the Red River is used as a source of drinking water by the downstream City of Selkirk and for vegetable and fruit irrigation. A recent survey of over 800 respondents indicated that 30% of Winnipeggers had undertaken at least one activity on their rivers, 60% had walked or cycled on the banks, and 67% wanted to make recreational use of the rivers. Sixty percent said that they were concerned by Winnipeg's pollution of its rivers.[20]

The oldest major city in the Prairie region, Winnipeg suffers from having been built prior to the development of modern sewer construction and sewage treatment techniques, as well as from being on a major river with relatively

low reliable flow. In addition, Winnipeg may have been less motivated to concern itself with surface water quality as a result of obtaining its fresh water supplies from Shoal Lake on the Manitoba-Ontario border in the Winnipeg River basin, since 1919. Primary treatment was commenced in 1939 following numerous complaints of odours, and secondary treatment began in 1966. While there are no current plans to upgrade treatment, contingency plans are being drafted in the event that the City is eventually ordered to do so as a result of recommendations of the Clean Environment Commission anticipated to be made to the Minister of the Environment in mid-1992.

The task of reversing this human degradation of the Red River is a daunting one. City engineers estimate that adding nutrient reduction and microbiological disinfection processes to the three existing PCCs would cost $145-190 million and that disinfection and treatment of wet water flow from Winnipeg's combined sewers would cost a further $500-1,400 million.[21] In the face of such a large cost, the City of Winnipeg has publicly questioned the existence of tangible benefits from further expenditures, although the casual observer might question whether the public duelling between the city and Manitoba Environment and the Clean Environment Commission is more about who pays and over what length of time than about whether it should be done.

Conclusion

In this issue of *Sustainable Cities*, we have focused on water and water quality in the Prairie grasslands region, one of Canada's most altered, and at the same time fragile, environments. We have focused more specifically on the interface between water quality in this fragile environment and its cities. It has been shown that Prairie cities and provincial governments, especially in the 1980s, have generally responded positively to ecological challenges, although many of the results of this effort will still not be seen until the late 1990s.

Prairie cities have generally responded positively to ecological challenges as they have grown in size and maturity. Partly from necessity, they have led the nation in servicing urban areas and treating effluent. More recently, they have also responded to the rising expectations of their citizens. In a 1991 study of the comparative quality of life in the seven largest Canadian cities and Halifax, the Angus Reid Group found that residents of Edmonton and Winnipeg were three times as likely to place sewage system improvement as the top priority, as the average for respondents in the eight cities.[22] Residents of Winnipeg were twice as likely to mention water quality. Residents of Calgary and Edmonton were two to four times as likely to mention lack of access to beaches as the worst aspect of their cities, as the average for all eight cities. Asked to place priorities on spending on a variety of services in the 1992 Winnipeg Area Study, residents of Winnipeg chose pollution control by an overwhelming margin.[23] In another Winnipeg opinion survey, 78% of respondents said that the city should increase spending for controlling river pollution, and 50% said that the city alone should bear the cost burden.[24]

It is obvious that more effort is required if Prairie city residents are to have the quality of life they require. The high priority of river pollution mitigation is also evident. The time when open water courses could be used as urban toilets is past.

Notes

1. Canada, Department of the Environment, *The State of Canada's Environment, 1991*, Table 17.1.

2. Statistics Canada, *Human Activity and the Environment, 1991*, Table 4.2.2.4. Data for all three groups of cities are unweighted. Total precipitation = rain + snow.

3. Canada, Department of the Environment, *op. cit.*, p. 17-7. Both major rivers also drain areas of the boreal plain not in the prairie grasslands, and 23% of the flow of the Saskatchewan River at The Pas originates in the boreal plain north of there. In addition, the Red River drains an area of approximately 126,000 km^2 in the U.S.A., and approximately 46% of the Red River flow into Lake Winnipeg has its origin in the U.S.A. About 27,000 km^2 of the extreme southerly portion of the Prairie grasslands drains into the Missouri River basin in the U.S.A.

4. Sharon Gurney, *Proposed Water Quality Objectives through Manitoba's Watershed Classification Process: Red and Assiniboine Rivers and their Tributaries Within and Downstream of the City of Winnipeg*, 1991. Winnipeg: Manitoba Environment, Technical Document, Figure 4.

5. Statistics Canada, *op. cit.*, Tables 3.3.5.1 and 3.3.5.2.

6. Canada, Department of the Environment, *op. cit.*, pp. 17-23. Total consumption = 2,630,000 dam^3 (1 dam^3 = 1000 m^3). Some observers have suggested that the reservoir behind the recently completed Rafferty Dam on the Souris River in Southeastern Saskatchewan may never fill entirely as a result of evaporation, and a federal environmental review panel recently suggested that the dam built recently on the Oldman River should be decommissioned, in part because a large portion of total water potentially stored may evaporate. Cf. *The Globe and Mail*, May 22, 1992, p. A-4.

7. 77% of water withdrawn for irrigation is consumed, while the ratio of consumption to withdrawal for other uses ranges from 1% for thermoelectricity to 15% for municipal withdrawals.

8. Calculated from P.H. Pearse *et al.*, *Currents of Change*, Final Report, Inquiry on Federal Water Policy, September 1985. Ottawa: Environment Canada, Tables 3.2, 4.1, 4.6 and 5.1.

9. *Ibid.*, Table 5.1.

10. *Ibid.*

11. Environment Canada, *The State of Canada's Environment, op. cit.*, P. 17-22.

12. D.A. Williamson, *Manitoba Surface Water Quality Objectives*, July 1988: Winnipeg: Manitoba Environment.

13. Charles S. Conyette, *A Review of Wastewater Treatment Systems, Processes and Water Quality Management Plans: Their Potential Application to the Red and Assiniboine Rivers*, 1991. Winnipeg: Manitoba Environment, Technical Report, p. 14.

14. Wardrop Engineering Inc. and TetrES Consultants Inc., *Study of Red and Assiniboine Rivers: Surface Water Quality Objectives*, August 30, 1991. Winnipeg: Manager of City of Winnipeg Department of Engineering, Waterworks, Waste and Disposal, p. 10.

15. However, any adverse impact on other jurisdictions that might potentially result from this lack of consistency is mitigated to the extent that Manitoba is almost always downstream of other jurisdictions. Although enforcement does not necessarily reflect principle, Alberta and Saskatchewan seem to be working towards the goal of assuring that all river waters are suitable for primary recreation, and the PWRB has made this a requirement for rivers flowing across provincial boundaries. Manitoba has nevertheless developed a regime and associated standards which relates surface water quality requirements to human use of the receiving water.

16. Alberta, *Bow River Recreation Study: An Assessment of Recreation Use and Economic Benefits*, c. 1988. Edmonton: Alberta Forestry, Lands and Wildlife.

17. *Calgary, Calgary River Valleys Plan: The Plan and Policies*, July 1984. Calgary: The City of Calgary, Planning and Building Department.

18. Manitoba, Clean Environment Commission, Verbatim Proceedings, Hearing H-03-9 1192, November/December 1991, pp. 4-149: Eva Pip.

19. Sharon Gurney, *op. cit.*, based on comparative usage.

20. Prairie Research Associates, Appendix F, in Wardrop Engineering and TetrES Consultants Inc., *op. cit.*

21. *Ibid.*, p. 15.

22. Cf. Institute of Urban Studies, *Newsletter*, December 1991.

23. Winnipeg: University of Manitoba, Department of Sociology, 1992. Results scheduled to be made available to the public in Spring 1993.

24. Dennis McKnight 2051 Inc., *A Quantitative Assessment of Attitudes and Opinions of City of Winnipeg Residents*, Prepared for City of Winnipeg Planning Department, November 14, 1991.

SUSTAINABLE CITIES

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A QUARTER CENTURY OF CANADA'S METROPOLITAN FRINGE DEVELOPMENT

The pace and nature of urbanization in Canada is rapidly transforming traditional urban centres into regional/urban complexes, a city form that encompasses a concentrated built-up area (the traditional city) and its dispersed surroundings: the fringe; the urban shadow; and the rural hinterland.[1] The different parts of regional cities are regarded as lying along a continuum of urban influence. The fringe, consisting of low-density residential development, dispersed commercial and industrial developments, idle land awaiting conversion to urban use and rural land uses, is the area undergoing transition from rural to urban land use.

It is commonly observed that the low-density development of the urban periphery may lead to numerous attendant environmental, economic and social problems, including transport-induced smog, the emission of large quantities of greenhouse gases to which recent and future climate change is often attributed, erosion of domestic non-renewable energy reserves potentially leading to increased dependence on foreign supplies, increased numbers of deaths and injuries from needless road accidents, deterioration in the quality of public spaces, increased social inequity associated with distance between affluent and poor urban residents, and increased social isolation and loneliness. Excessive low-density development may also result in erosion of agricultural land reserves. Gridlock, the threat to future mobility generated by excess automobile dependence and attendant traffic congestion, presents a future crisis stemming from recent and current development patterns on the periphery of our largest cities. A poll by the Angus Reid Group in 1991 showed that about 50% of large-city Canadians resident in downtown or inner-city areas used cars to commute to work, while about 80% of those in new suburbs did so.[2]

For many Canadians the metropolitan fringe presents a positive residential opportunity. The aforementioned public opinion survey found that the notion of living beyond the built-up urban area possessed "a lot of appeal" for 26% of large-city residents, and almost two thirds of these anticipated the likelihood of making good on this appeal over the next five years. And while 32% currently lived in areas they characterized as "new suburban," 36% expressed a desire to live in a new suburb.

Most new urban development has been and is occurring on the periphery of our urban areas. This is only natural, as most urban growth has historically been accommodated on rural land on the periphery of urban centres. It is the nature, form and density of development of the urban fringe that is therefore critical to the achievement of sustainable city objectives. As about 78% of Canadians live in urban areas, how those areas develop is of increasing interest to Canadians. In this issue of *Sustainable Cities*, we examine the recent patterns of metropolitan development and the impact associated with development patterns on the metropolitan fringe.

Canada's Recent Growth and Development Patterns

Census data for 1991 recorded the first increase in the intercensal population growth rate since the 1951 Census.[3] The recent increase is due to a combination of increased immigration, decreased emigration and stable natural increase. Equally significant, the 1991 Census revealed that 61.1% of Canada's population lives in 25 census metropolitan areas (CMAs), an increase from 51% in 1966 and 59% in 1981.[4]

Canada is increasingly a nation of large cities. Almost four of five persons added to Canada's population during the decade of the 1980s was resident in Canada's CMAs in 1991. And growth in large cities is increasingly dispersed in the fringes of those cities. Urban places are rapidly becoming urban spaces.

Canada's CMAs may be divided into urbanized cores and fringes. The urbanized core is defined herein as Census subdivisions (a central city and often adjoining municipalities) with gross population densities of 10 persons per hectare (ha) or greater (average in 1991 of 15 persons/ha), while the remainder of the population in each CMA resides in the "fringe."[5]

Table 1 indicates the distribution of metropolitan growth from 1966 and 1981 to 1991. Rates of growth for individual cities and CMAs varied considerably, both individually and in groups and over time. The national rate of population growth through the 1980s was 12.1%, virtually identical to the rate of growth from 1971 to 1981, although considerably less than the 18.2% experienced from 1961 to 1971. Canada's CMAs grew by approximately 16% through the 1980s (1981-1991), while population not resident in CMAs grew by 6% during the period. The higher rate of growth for CMAs resulted from net positive migration flows from non-CMAs, as well as nearly record levels of net migration (immigrants less emigrants) from abroad. Through the 1980s nearly 60% of the net growth occurring in Canada's CMAs and almost half the net population growth of Canada was situated in the fringe areas of CMAs outside the urbanized core. The proportion

TABLE 1: METROPOLITAN POPULATION AND DENSITY TRENDS, 1981 - 1991

	Population (000)			% Canada		% Change		Area (ha)		Density (pop/ha)	
	1966	1981	1991	1966	1991	1966-91	1981-91	1966	1991	1966	1991
MONTREAL, TORONTO, VANCOUVER											
Central Cities	2,297	2,032	2,125	11	8	(7)	5	35,280	38,750	65	55
Rest of Urbanized Core	3,090	3,533	3,969	15	14	28	12	254,720	180,910	12	22
Fringe	100	1,696	2,529	0.5	9	2,429	49	181,050	968,210	0.6	3
3 CMA's Total	5,488	7,261	8,623	27	32	57	19	471,050	1,187,870	12	7
QUEBEC, OTTAWA, HAMILTON											
Urbanized Core	1,271	965	1,005	6	4	(21)	4	98,480	45,750	13	22
Fringe	86	904	1,161	0.4	4	1,250	28	164,560	918,964	0.5	1
3 CMA's Total	1,357	1,870	2,166	7	8	60	16	263,040	964,714	5	2
WINNIPEG, EDMONTON, CALGARY											
Urbanized Core	1,210	1,731	1,986	6	7	64	15	106,470	197,260	11	10
Fringe	30	226	260	0.1	1	767	15	54,370	1,593,996	0.6	0.2
3 CMA's Total	1,241	1,957	2,246	6	8	81	15	160,840	1,791,256	8	1
16 SMALLER CMA'S											
Urbanized Core	1,999	2,209	2,394	9	9	20	8	160,790	289,500	12	8
Fringe	197	1,016	1,236	1	4	527	22	319,120	2,685,761	0.6	0.5
16 CMA's Total	2,196	3,225	3,630	11	13	65	13	479,910	2,975,261	5	1
25 CMA'S											
Urbanized Core	9,867	10,470	11,480	49	42	16	10	655,740	752,170	15	15
Fringe	413	3,843	5,186	2	19	1,156	35	719,100	6,166,927	0.6	1
25 CMA's Total	10,280	14,313	16,665	51	61	62	16	1,374,840	6,919,100	7	2

Source: Statistics Canada, Census of Canada (various years)

of total metropolitan population residing in fringe areas increased from 4% in 1966 to 27% in 1981 and 31% in 1991.

The short-term pattern from 1981 to 1991 differs from the pattern of development over the longer term. From 1981 to 1991, rates of growth were more or less associated with city size class: the larger the class of city, the greater its growth. This pattern was fuelled both by net internal and external migration. Thus the three largest CMAs–Montreal, Toronto and Vancouver–with over one million population each grew by 19%; the six CMAs with populations of 500,000 to 1 million–Quebec, Ottawa, Hamilton, Winnipeg, Calgary and Edmonton–grew by 16%; and the 16 smaller CMAs with populations of 100,000 to 500,000 grew by 13%.

With the exception of the three Prairie metropolises, fringe areas grew considerably more rapidly than the central cities or urbanized cores. The extent of fringe growth, as well as the magnitude of the differential between growth in the urbanized core and in the fringe varied in the direction of city size. Fringe area growth was 49% for the three largest cities, 28% for the other three large Eastern cities and 22% for the 16 smaller CMAs. In the case of the Eastern CMAs with populations 500,000 to 1,000,000, fringe populations exceeded populations of the urbanized core for the first time in 1991.

A notable exception to the above generalization is presented by the largest three Prairie metropolises. The fringe areas comprised less than 12% of total CMA population in 1991, and both the urbanized cores and fringe areas grew by equal amounts (15%) between 1981 and 1991. What also characterizes these three cities is that they are among the few cities in Canada that continue to grow by means of annexing fringe areas, and they are developed at relatively low urban densities–less than half that of the three Eastern cities in the same size class and a little more than one-fourth that of the urbanized cores for the three largest metropolises. In 1991, the urbanized cores of Calgary, Edmonton and Winnipeg contained 17% of the population of all urbanized cores, but occupied 38% of the total land area. Together, the Prairie metropolises contained 374 farms occupying nearly 55,000 hectares in 1986. Excluding area occupied by farms, which comprised approximately 30% of the land area of the urbanized cores in 1986, these three urban cores would average a density of about 15 persons/hectare, still about one-third less than the density of the three Eastern metropolises with similar population. There was also a 37% increase in the land area of the three Prairie central cities between 1981 and 1991, and this constituted almost 55% of the land area added to Canada's urbanized cores in the 1980s. Territorial increments in the areas of the 16 smaller cities accounted for 43% of land added to urbanized cores.

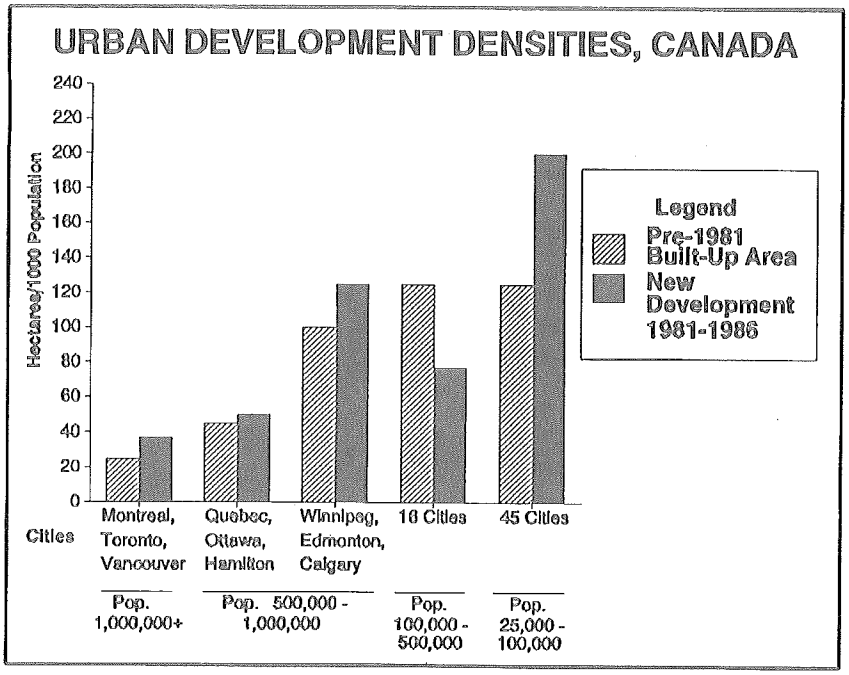
Growth rates by city size over the longer period from 1966 to 1991 were nearly the inverse of the shorter period. Smaller CMAs tended to have the highest rates of growth.

The most remarkable geographical aspect of development over this quarter-century period was the rate of growth in the metropolitan fringe. While the population of the urbanized cores of the 25 CMAs grew by 16%, the population of the fringe areas increased by over eleven fold, from 413,000 to almost 5.2 million. The fringe areas of the three largest cities recorded the most rapid growth–almost 25 times–and the proportion of Canadian fringe population residing in fringe areas of the three largest CMAs

increased from under 25% to almost half (49%) of the total fringe population.

Even more remarkable was the extent of geographic growth. In 1966, fringe areas of the 25 CMAs occupied 719 km^2, an area only slightly larger than the 656 km^2 occupied by the urban cores, and by 1991 this had increased almost nine times to 6,167 km^2. In 1991, this much larger area was occupied at approximately twice the density that the smaller area had been occupied in 1966. While a change in procedure by Statistics Canada between 1966 and 1991, which eliminates the designation of parts of municipalities as part of a CMA, has undoubtedly increased the geographical extent of fringe areas in CMAs, the fact that the density of development in fringe areas nearly doubled in the 25 years and the knowledge that designation now follows labour force commutation zones justifies the conclusion that the total urban field of the 25 CMAs, which increased by over five times, increased disproportionately to population (62%).

FIGURE 1



SOURCE: Environment Canada, Urbanization of Rural Land in Canada, 1981-86, a State of the Environment Fact Sheet

Projecting Recent Trends into the Future

Projections into the future are always risky exercises. That Statistic Canada's most recent long-term population projections, based on the 1986 Census and published in 1989, underestimated 1991 population totals by nearly 2% is in itself a cogent indicator of such riskiness.[6] Urban observers, analysts and policymakers do nevertheless need to ponder the results stemming from a continuation of recent trends into the future. The following scenario has been developed for the year 2011.

Assuming that future trends, especially with respect to net migration from abroad, reflect those of the recent past, Canada's population in 2011 would approximate 33 million.[7] About 21,212,000, or 64.3% may be expected to live in CMAs. Population of the urbanized cores is projected to increase by 13% to 12,890,000, and the population of the fringe areas is projected to reach 8,232,000, an increase of 59%.[8]

Assuming roughly constant propensities to use various modes of transport, such results would lead to an approximate 27% increase in commuting by car in Canada's CMAs and an even greater increase in total car usage. Use of public transit would also increase, but from 50% to 60% of new users would be residents of fringe areas. And it is the low-density fringe bus routes that most often mean losses to transit companies. As the primary mode of transportation from home to work and assuming the same propensities as in 1991, urban transit use will have decreased from 23% in 1991 to 19% for the largest cities in 2011. Many observers would label this an optimistic view, as urban transit use has declined by a larger number in the past two decades, and work places are becoming increasingly dispersed, rendering them difficult to serve by public transit, in most cities.

Rural to Urban Land Conversion

The urbanized cores of Canada's major cities are almost by definition–excepting the Prairie cities noted above–fully developed. Again, concern for its implications for Canadian urban development is focused on the nature, form and density of new development. Some observers have noted that a density of approximately 45 persons/ha is required to support reasonably frequent bus service, and a density of about 60 persons/ha, about the same as the central cities in the three largest CMAs, is required to support light rail transit.[9] The land resource loss, certainly in the case of prime agricultural lands that adjoin Canada's large cities, is also of concern, and this section focuses on the conversion of rural land to urban use.

While the program was discontinued in 1988, Environment Canada monitored the conversion of rural to urban land from 1966 to 1986. Aerial photographs were utilized until 1981, while the most recent data were obtained through Canada's remote/satellite sensing program. One of the values of this service is that it allows the researcher to identify particular growth increments and actual rural land converted to urban uses, although there is some concern that this method understates the impact of dispersed and scattered residential fringe development on agriculture and other rural land-uses. These data also allow the analyst to measure intensity of land-use in cities such as those on the Prairie, where municipal boundaries are not necessarily of assistance in measuring suburban sprawl. As can be seen in Table 2 and Figure 1, the fringe areas of Canadian cities were developed at densities considerably lower than those amenable to service by public transport during the 1980s. Densities varied from five persons/ha for the 45 Census Agglomerations with populations between 25,000 and 100,000 to 27 per-

TABLE 2: URBAN CONVERSION OF PRIME AGRICULTURAL LAND, 1981-1986

CITY	HA/1000	POPULATION CHANGE (000)	TOTAL HA LAND CONVERTED	HA PRIME AGRICULTURE	90 CANADA
Edmonton	90	44	8774	4036	12
London	60	15	903	894	3
Winnipeg	51	33	2092	1674	5
60 Remaining Cities	48	171	18,056	8,306	25
Montreal	44	61	3,373	2,665	8
Calgary	38	45	3,575	1,716	5
Toronto	35	286	10,358	10,047	31
Ottawa	31	71	3,603	2,234	7
Hamilton	26	15	499	395	1
Quebec	23	13	771	293	1
Vancouver	4	112	3320	498	2
TOTAL	38	866	55,324	32,758	100

Source: Environment Canada, Urbanization of Rural Land in Canada, 1981-86, a State of the Environment Fact Sheet

sons/ha for the three CMAs with populations over 1,000,000).

Environment Canada estimates that over 55,000 ha of rural land was converted to urban uses between 1981 and 1986. Almost 60% of this consisted of prime agricultural land.[10] As is shown in Table 2 and in part owing to their unique locations and land characteristics, Canada's cities varied considerably in the utilization of land for urban purposes, as well as in the impact of land-use on prime agricultural lands.

Generally, cities in Southern Ontario converted the largest proportions of prime agricultural land to urban uses: 99% for London and 97% for Toronto. While net development densities for Toronto were a fairly efficient 28 persons/ha, the dominance of prime agricultural land as a proportion of total land converted meant that Toronto was responsible for the loss of 31% of prime agricultural land converted for about 33% of net new urban population added. Edmonton was Canada's least efficient and most profligate converter of rural land to urban purposes during the period 1981-1986, with net densities of five persons/ha, less than one third of the Canadian average. The other two major Prairie urban centres also saw low average densities in this period: 12 persons/ha in Calgary and 16 persons/ha in Winnipeg. The three major Prairie urban centres accounted for 26% of all rural land converted and 15% of net new urban population. The next lowest densities were generally in Quebec: 17 and 18 persons/ha in Quebec and Montreal, respectively. Vancouver, with a net density for new development of 34 persons/ha experienced the densest development during this period.

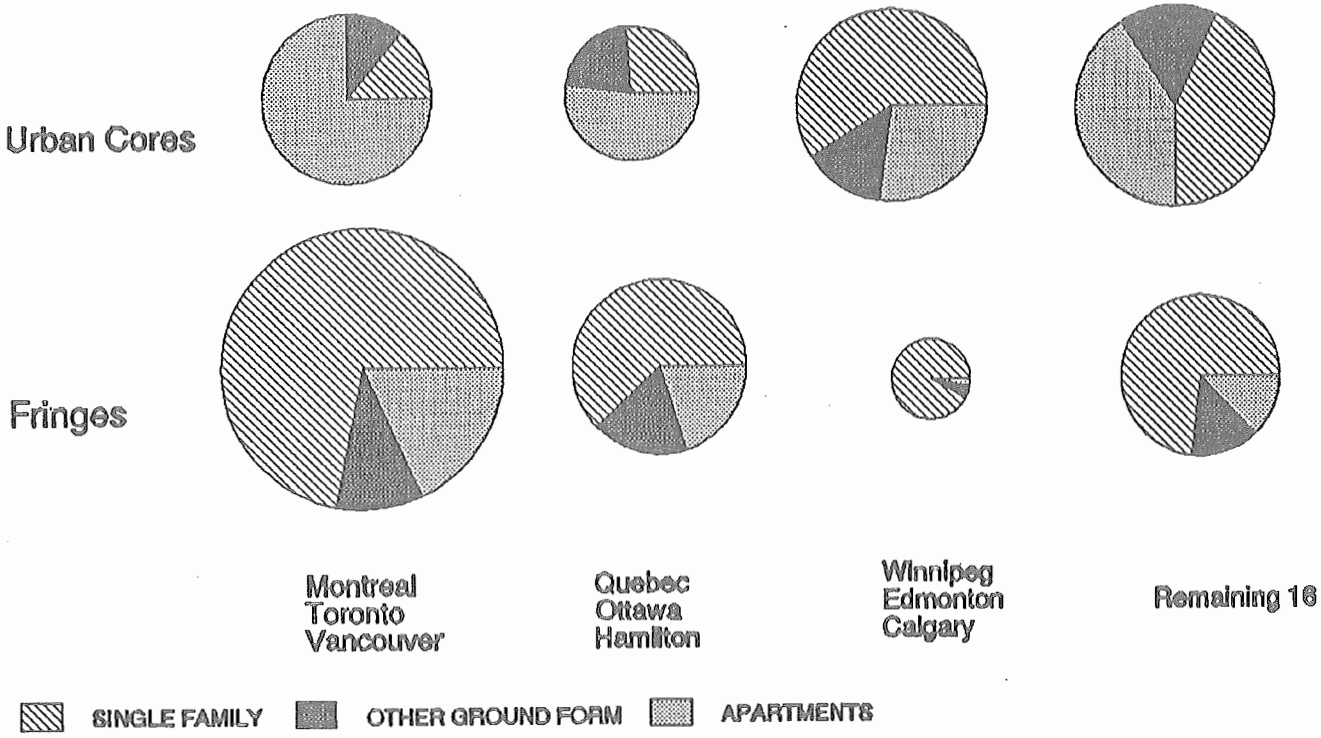
Also noteworthy during this period is the comparative experience of Quebec and British Columbia with respect to the conversion of prime agricultural lands. Both provinces have provincial legislation designed to protect prime agricultural lands from urban conversion. The data indicate that British Columbia may have been fairly successful in its efforts to protect prime agricultural land, while Quebec was quite unsuccessful. Only 15% of land converted for urban use in Vancouver was rated as prime agricultural land by Environment Canada, while 79% of land converted in Montreal was rated as prime agricultural land. As well, new development in Vancouver was on average almost twice as dense as similar development in Montreal. However, it is not entirely certain that the comparative policies of agencies and governments administering provincial legislation is responsible for these differences. Earlier data from Environment Canada indicate that only 18% of land converted during the period before British Columbia enacted its legislation was prime agricultural land, while 50% of Quebec land converted was prime agricultural land.[11]

For the longer 20-year period (1966-1986) for which Environment Canada monitored rural land-use conversion, over 300,000 ha was converted, representing approximately 40% of the total area of urbanized cores in 1986 on which about 30% of metropolitan population resided in 1986.

Definitive conclusions regarding the impact of rural to urban land conversion on agriculture and farming are difficult to formulate. The economics of agricultural production and agricultural markets have likely just as large or larger impact overall as land-use change. For instance, while the amount of land devoted to agriculture in the vicinity of large cities has decreased, the amount of the decrease appears to bear little resemblance to the amount of land actually converted from rural to urban use, as depicted by Environment Canada data. Farm data for the three Eastern cities with populations of 500,000 to 1,000,000–Quebec, Ottawa-Hull and Hamilton–show a loss of approximately 73,000 ha of improved farmland from 1966 to 1986, while the Environment

FIGURE 2

DWELLINGS COMPLETED BY TYPE, BY CLASS, 1981 - 1991: CENSUS METROPOLITAN AREAS



NOTE: Circle sizes portray relative numbers of dwellings completed.

SOURCE: Canada Mortgage and Housing Corporation

Canada data indicate the conversion of about one third of that amount to urban uses. Data for the three Western cities with similar populations–Winnipeg, Edmonton and Calgary–indicate that approximately 60,000 ha might have been converted from rural to urban use over the two decades, but the amount of improved farmland within the three CMAs actually increased. Farm data for the cities of Calgary and Winnipeg and their immediate vicinity indicate the loss of 20,000 ha in improved farmland in each city, which is consistent with the land-use data from Environment Canada.

While definitive conclusions on the implications of conversion of such quantities of rural land are difficult, it seems certain that they extend beyond the impact on agricultural production, which has continued to increase over the past 25 years. The potential damage to future production from wind and water erosion and from nutrient depletion is certainly a much greater national concern than conversion to urban uses. Other factors, such as the amenity, landscape and recreational value of farmland near regional cities and other potential land uses required to support contemporary urban populations may be more important than the agricultural value of converted rural lands. Some expert observers have suggested that policy-makers construct scenarios of future requirements as part of formulating policies on directing future urban growth.[12]

Land Conversion and Housing Construction

Data compiled with the assistance of the Canada Mortgage and Housing Corporation confirm that the most popular house form during the 1980s was the single-family house–52% of all completions in the 25 CMAs. About 35% of completions were apartments, and the remaining 13% were duplexes and row houses. The proportion of all completions comprised of single-family homes was significantly different than the large-city national average only in the three large Prairie cities, where it comprised 62%. It was 49% for the three largest metropolises, 50% for the average of Quebec, Ottawa and Hamilton and 54% for the average of the 16 smaller CMAs.

Figure 2 shows that single-family home construction was the dominant type of completion in the fringe areas–70% for the 25 CMAs combined, and 72% for fringe areas of the three largest metropolises, 62% for the average of the three mid-sized Eastern metropolises, 92% for the fringe areas of the three large Prairie metropolises and 73% for the fringe areas of the 16 smaller CMAs.

While residential construction was considerably more buoyant in the last half of the 1980s than in the first half, there were few noticeable trends in type of completion through the decade. There was a small decrease in the proportion of completed dwellings com-

prised of the medium-density types–duplexes and row houses–from the early to late 1980s. Regionally, completions of single-family homes increased from 52% to 77% of the total from the early to late 1980s in the three large Prairie cities.

Future Policies?

The problems created by unbridled urban growth, including the considerable impact on capital and operating budgets, and the need for governments to play a larger role in establishing principles for guiding future urban development, are beginning to be addressed by local and provincial officials. Local governments and the urban planning departments of cities of all sizes are producing plans and policies embodying "sustainable development" themes, as are local and provincial round tables on the environment and the economy. The ways and means of reducing excessive automobile dependence in Canadian urban regions is being addressed by planners, although few if any specific plans for reducing emissions have been formulated.

The efforts of two provinces stand out among those of the rest. Having splintered a cohesive planning approach to growth in the Toronto-centred region in the 1970s by creating five upper-tier regional governments, each with exclusive planning jurisdiction within their own part of the total area, the Government of Ontario created the Office of the Greater Toronto Area in 1989. The report, *GTA 2021–The Challenge of Our Future*, identifies the social, economic and environmental effects of urban sprawl. This working document is intended to provide a basis for formulating a strategic action plan in the near future. This provincial document is supplemented by the report, *Regeneration*, by the Royal Commission on the Future of the Toronto Waterfront. While its report is not scheduled to be published until April 1993, Ontario has also indicated at least a tentative commitment to addressing issues of urban development by its appointment of a Commission on Planning and Development Reform in Ontario. As it has focused a major part of its research efforts on waste water treatment for scattered development not serviced by municipal services, it may be anticipated that its report will address sparse development in metropolitan fringe spaces.

In British Columbia, the provincial government has indicated its commitment to formulate guidelines for planning in the Vancouver region by the end of 1993. British Columbia created a Commission on Resources and Environment in July 1992, and it published its *Land-use Charter* in August. While its primary focus will be on British Columbia's primary resources, this work will have an impact on land-use decisions in urban areas as well.

While the efforts in these two provinces with Canada's greatest urban development pressures are the most promising, that virtually every province is closely examining its planning framework and principles needs to be emphasized.

Jeffrey Patterson
Senior Research Fellow

NOTES

1. The definitions used herein are summarized more fully in Claude Marchand and Janine Charland, *The Rural-Urban Fringe: A Review of Patterns and Development Costs* (Toronto: ICURR Press, 1992) and in C.R. Bryant *et al.*, *The City's Countryside: Land and its Management in the Rural-Urban Fringe* (New York: Longman's, 1982).

2. Angus Reid Group, *Urban Canada Study, 1991*. Cf. *Sustainable Cities*, 1992, Issues 1 and 2.

3. Statistics Canada, *The Daily*, April 28, 1992.

4 A CMA is characterized by Statistics Canada as an urbanized core, sometimes one central city but often several municipalities, at the centre of a labour market commuting zone of 100,000 persons or more.

5. The reader is cautioned that the fringe, as defined by geographers, is likely greater in extent than the area included in CMAs. CMA boundaries include areas in which 50% or more of workers commute to a central city. Significant numbers of commuters are likely to be generated in areas outside which this threshold requirement might not be met.

6. Statistics Canada, *Population Projections for Canada, Provinces and Territories, 1989-2011*. Ottawa: Catalogue 91-520 Occasional, 1989. Note that an undetermined proportion of the magnitude of the gap between the highest future projection and the actual 1991 population consisted of non-permanent residents, including refugee claimants, who were counted for the first time in 1991.

7. Statistics Canada's projection number 4 for 1989 was increased by 1.8% to 32,981,000.

8. Author's projection. Assumes 80% of growth occurs in CMAs and that two thirds of CMA growth occurs in fringe areas of CMAs.

9. Cf. Marcia D. Lowe, "Shaping Cities," in Lester R. Brown, ed., *State of the World, 1992* (New York: W.W. Norton and Co., 1992), pp. 119-37.

10. Canada, Department of the Environment, "Urbanization of Rural Land in Canada: 1981 - 1986," *A State of the Environment Fact Sheet* (Ottawa: Department of the Environment, State of the Environment Reporting Branch, 1989).

11. Ibid., Table 3.

12. Christopher R. Bryant and Thomas R.R. Johnston, *Agriculture in the City's Countryside* (Toronto: University of Toronto Press, 1992).

SUSTAINABLE CITIES

ISSUE ■ NO. 5 IUS NEWSLETTER SUPPLEMENT DATE ■ WINTER 1993

AN ORDERING OF PREFERRED ENVIRONMENTAL ACTIONS

With funding from the Institute of Urban Studies in 1992 the Winnipeg Area Study included two questions with 16 parts in its annual survey of Winnipeg residents. A summary of the results are reported in this issue of Sustainable Cities.

In the spring of 1992 the Winnipeg Area Study (WAS), a project of the Sociology Department of the University of Manitoba, carried out its tenth socio-demographic survey of Winnipeg residents. Previous surveys were carried out in 1981, 1983, 1984 and annually since 1986.

The 1992 WAS survey instrument was an amalgam including questions from a number of researchers with respect to social situations, crime and protection, municipal services and taxation, child discipline and work, employment and education in addition to questions on the urban environment commissioned by the Institute of Urban Studies. These were the first questions on ecology to be included in the WAS since the initial survey in 1981.[1]

Urban Environmental Questions

That Canadians have considerable concern for environmental and ecological issues in general is now well established in the sociological literature. It is also increasingly accepted that the effect of this concern on individual behaviour and actions is highly conditioned by situation and context.[2] That is, whether or not an individual undertakes a particular action or form of behaviour, such as reusing or recycling household waste or switching mode of transport to work from the private automobile, is highly dependent on the availability and accessibility of alternatives.

In addition to exploring the opinions of Winnipeggers with respect to such issues, the Institute's objective in including these questions in the WAS, 1992, was to determine the contexts and situations that might be conducive to mitigating environmental and ecological stress occasioned by current urban development practices and policies. While the specific questions were administered only to residents of Winnipeg, similarities to the opinions and preferences expressed by the residents of other urban areas lead to the assertion that the results may be generalized to residents of other large urban centres.

The two questions were therefore formulated to elicit answers to a range of environmental actions judged to be critical to the achievement of more environmentally sustainable urban development in the future. This range of actions includes switching work and other trips from the automobile to other modes or urban transportation, conserving fuel for household space conditioning, reducing, reusing and recycling household waste, and the development of more efficient urban form.

In the first of the two questions, respondents were asked to indicate their level of agreement with seven selected statements with respect to the efficacy of environmental actions. A four-part scale–strongly agree, somewhat agree, somewhat disagree, or strongly disagree–was applied to each of the eight parts:

a. Only higher fuel taxes and higher parking fees will make urban commuters consider public transport seriously.

b. Public transport will present a real alternative to private cars only when access and convenience are improved.

c. Individuals can best contribute to increased environmental quality by reusing and recycling household waste.

d. The City of Winnipeg should devote much greater effort to purifying sewer effluent to its major rivers.

e. Greater reliance on public transport is NOT an option in a mid-sized city such as Winnipeg, and a high priority should be placed on requiring more efficient cars and trucks or the use of alternative fuels.

f. The City and Province of Manitoba need to protect agricultural lands from urban expansion.

g. As Winnipeg is growing slowly, the development of new subdivisions on the periphery only adds to municipal costs and results in fewer funds for maintaining services and facilities in older neighbourhoods.

h. The City should levy user fees for than one bag/can of garbage to encourage more recycling and composting.

In the second question respondents were asked to indicate whether they definitely would, would, definitely would not, or this is something that they

TABLE 1
GREEN PRIORITIES: DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS

	AGREE (%)		DISAGREE (%)		REGRESSION COEFFICIENT			
	Strongly	Somewhat	Somewhat	Strongly	Sex	Community of Residence	Income	Age
Fuel taxes, etc., necessary to move people to take public transit	10	29	38	22	.15*	.01	-.10	nil
Improved access/convenience will make public transportation alternative	43	40	13	4	.06	nil	-.01	-.02
Re-using/recycling most important for environment	69	27	4	1	.07	.05	.02	.08
Winnipeg should purify sewer effluent	73	23	3	1	.06	nil	-.09	.03
Health priority needs to be placed on car efficiency vs. public transit	27	43	21	9	.01	.04	-.02	.02
Needs to protect agricultural lands	46	34	17	3	.09*	.04	-.10	.01
Needs suburbs add to municipal costs and should be discouraged	33	41	21	5	.04	nil	-.05	.10
Reduced garbage generation by levying fee on more than one bag	31	23	13	33	.10*	.02	-.04	-.10
	Definitely Would (%)	Would (%)	Would Not (%)	Definitely Would Not (%)				
Bike to work if bicycle lanes	31	23	13	33	.03	.07	-.15*	-.30*
Gas double; switch to transit or bike	32	27	17	24	.11*	-.10*	-.24*	-.14*
Willing to take recyclables to depot	55	29	8	8	.06	.02	-.03	-.14*
Willing to participate in box recycling	57	28	8	8	.04	.02	nil	-.13*
Will compost to avoid garbage fees	35	33	17	15	.05	.04	-.04	-.17*
Will use programmable thermostat	56	28	8	9	.09	.02	.08	-.06
Willing to live in denser housing	13	17	25	45	.02	.06	-.22*	-.10*
Support zoning for denser housing	13	28	24	34	.08	.05	-.12	-.08*

Source: Winnipeg Area Study, 1992, IUS Tabulations

already do with respect to a number of hypothetical situations in the future:

a. If reserved bicycle lanes were created would you bike to work outside of winter months? (A pretest had established that few Winnipeggers would consider biking to work in winter months under any hypothetical circumstances).

b. If the price of gasoline doubled (to $1.00 per litre) would you switch from car to public transit or a bicycle (in summer) for work trips?

c. Would you be willing to take your reusable/recyclable household waste to central collection points if these were established by the City?

d. Would you participate in a "blue box/red box" curbside collection program?

e. Would you compost yard and kitchen waste to avoid extra user fees for garbage collection?

f. If the price of home heating increased by one half, would you invest in a programmable thermostat that reduces the heat when you are not home and at night?

g. Would you be willing to move to a denser form of housing with the same living space to save fuel used for transportation, heating and air conditioning?

h. Would you support zoning and planning measures resulting in greater dwelling densities in your neighbourhood to save fuel used for transportation, heating and air conditioning?

Summary of Survey Results

Responses to questions regarding the first and second most important issues currently facing Manitobans confirmed that the environment is viewed as one of the most critical, although in the spring of 1992 the environment and all other unrelated issues followed those stemming from the deep economic recession by a considerable distance. Over 58 percent of respondents identified the economy, economic growth and stability and the economy as the most important issue or issues facing Manitoba. All other issues paled in comparison. Almost four percent identified education or post-secondary education, and almost three percent identified health care costs. Over two percent identified the environment.

While the economy or some aspect of the economy was also the most often mentioned second issue, air pollution, pollution, ecology, natural resources or environment was the second most often mentioned problem. These items were mentioned by almost seven percent of respondents. Education, post secondary education and their costs and health care and costs were each mentioned by slightly fewer respondents.

Table 1 summarizes agreement/disagreement with the eight parts of question 1 and the indicated behavioural responses to the eight hypothesized scenarios and relationship of responses to sex, community, income and age of respondent.

The statement with which there was the highest level of agreement was that the City of Winnipeg should devote much greater effort to purifying sewer effluent. Seventy-three percent said that they agreed strongly with this statement, and over 23 percent responded that they were somewhat in agreement. Only four percent indicated any disagreement. Support for the statement that individuals can best contribute to increased environmental quality by reusing or recycling household waste, strongly agreed to by 69 percent of respondents and somewhat agreed to by a further 27 percent, was not far behind. It might be argued that respondents were not in support of the notion of eliciting greater commitment to reusing or recycling household waste by penalizing those who continued to be profligate wasters. Only 31 percent strongly agreed with the statement that a fee should be levied for more than one bag/can of garbage per week, although a slightly greater proportion of respondents strongly or somewhat agreed with this statement than somewhat or strongly disagreed with it–56 *vs.* 44 percent. That those who felt strongly one way or the other comprise almost two thirds of total responses is likely an indication of the intense debate that might be anticipated as a result of specific proposals in this respect.

Questions also eliciting a high degree of agreement were those relating to development at the urban/rural fringe. Forty-six percent of respondents strongly agreed with the statement that the City of Winnipeg and Province of Manitoba needed to protect agricultural lands from urban expansion, and a further 34 percent said that they were somewhat in agreement with this statement. A smaller but still significant proportion of Winnipeggers accepted the notion that new suburban development adds to municipal costs and diverts scarce municipal funds from satisfying needs for maintaining services and facilities in older neighbourhoods, a statement agreed to strongly by 33 and somewhat by 41 percent of respondents.

Responses to the statements about urban transportation preferences provide potentially valuable conclusions regarding policy pursuits in this area. While opinions were not as strong one way or the other as they were on the statement regarding fees for excess household waste, this was the only one of the eight parts of this question on which there was overall disagreement, strongly by 22 and somewhat by 38 percent of respondents. And while there was overall agreement with the statement that mid-sized cities such as Winnipeg would benefit more from progress in increasing the efficiency of automobile transportation than from pursuing the option of greater reliance on public transport, there was even greater agreement with the statement that public transport will present a real alternative to private cars only when access and convenience are improved. Forty-three percent strongly agreed, and 40 percent were somewhat in agreement with this statement.

The hypothetical situations for which respondents were asked to indicate the extent to which they would alter their current behaviour represented a wide spectrum of difficulty with respect to their intrusion on current lifestyles, and it is therefore not surprising that the responses represented an equally wide spectrum. The three situations which would bring about the largest favourable alteration in behaviour were also those that required the least personal effort. In response to the question regarding willingness to buy a setback thermostat should the price of energy increase by 50 percent, 56 percent said that they definitely would, and a further 28 percent were slightly less committed and said that they would. Only 17 percent said that they would not or definitely would not.

Some of the most spirited debate in Winnipeg civic politics over the past decade has focused on the City's responsibility for facilitating the recycling of household waste. Winnipeg is currently one of the few major cities in Canada not to operate a program of any kind.[3]

Debate has centred on whether a curbside recycling service should be added to existing municipal household waste disposal services or whether convenient recycling depots should be established? While the literature strongly indicates that significant use of opportunities will only occur with the provision of a curbside program, the survey results nevertheless indicate that approximately the same proportion of respondents would make use of either service; 55 percent of respondents said that they would definitely take recyclables to a depot, and 57 percent said that they would definitely participate in a curbside program.[4] In both instances 16 percent that they would not or definitely would not participate, and this approximates the national rate of non-participation in household waste recycling programs of 14 percent. Significantly fewer respondents–35 percent definitely would and 33 percent would–said that they would compost kitchen and yard wastes to avoid additional user fees for garbage collection.

The survey results indicate that a much smaller proportion of respondents would be willing to switch work transportation modes in response to two hypothetical situations. Thirty-one percent said that they would definitely switch to biking to work in the summer if special bicycle lanes were provided, and another 23 said that they would.

TABLE 2
POLITICAL PARTY SUPPORT AND ENVIRONMENT CONCERN

		POLITICAL PARTY PREFERENCE			
		Federal		Provincial	
	Mean	R	Significance	R	Significance
Fuel taxes, etc., necessary to move people to take public transit	2.16		NEG		NEG
Improved access/convenience will make public transportation alternative	3.16		NEG		NEG
Re-using/recycling most important for environment	3.56	-.16	.10	-.12	.11
Winnipeg should purify sewer effluent	3.67	-.05	.02		NEG
Health priority needs to be placed on car efficiency vs. public transit	2.86	.08	.01		NEG
Needs to protect agricultural lands	3.20	.03	.01	.02	.01
Needs suburbs add to municipal costs and should be discouraged	2.64		NEG		NEG
Reduced garbage generation by levying fee on more than one bag	2.54		NEG	-.06	.07
Bike to work if bicycle lanes	2.64	.05	.01		NEG
Gas double; switch to transit or bike	3.27		NEG		NEG
Willing to take recyclables to depot	3.27		NEG		NEG
Willing to participate in box recycling	3.27		NEG		NEG
Will compost to avoid garbage fees	3.43		NEG		NEG
Will use programmable thermostat	3.27	.06	.01		NEG
Willing to live in denser housing	1.91	-.08	.01		NEG
Support zoning for denser housing	2.16	.01	.01		NEG
All	2.89	NA	NA	NA	NA

Source: Winnipeg Area Study, 1992, IUS Tabulations.

TABLE 3
GREEN CITY OPINIONS AND MUNICIPAL SPENDING LEVEL PREFERENCES

	Strongly Agree %	Less Agreement %		Strongly Agree %	Less Agreement %
Public transport will present a real alternative to private cars only when access and convenience are unproved	83	17	City should devote much greater effort to purifying sewer effluent. Pollution control spending.	74	26
Public transport spending levels					
Lot more	12	2		38	21
Somewhat more	49	27		50	54
Same	37	65		12	22
Somewhat	2	8		NIL	2
Lot less	NIL	1		NIL	1
Correlation	r=.26			r=.19	

Source: Winnipeg Area Study, 1992, IUS Tabulations.

Similar proportions–32 and 27 percent, respectively of those driving cars to work–said that they would definitely switch to public transit or biking if the price of automobile fuel were to double to $1.00/litre.

The survey underscores the extent to which Winnipeggers are committed to living in single family houses. Forty-five percent said that they would definitely not consider moving to a denser housing form with the same amount of space to save energy, and another 25 percent said that they would not. On the other hand, it may be promising that 13 percent said that they definitely would, and 17 percent said that they would. This commitment to single family housing extends for most respondents to protecting the integrity of existing neighbourhoods from intrusion by denser housing forms. Almost 60 percent said that they would not or definitely would not support rezoning and planning proposals in support of denser house forms in their current neighbourhoods.

Characteristics of Those Concerned for the Environment

Results of previous surveys of environmental concern and willingness to alter behaviour and habits to achieve environmental objectives and mitigate environmental degradation have generally found little or no correlation with age, sex, education, income, or political ideology.[5] Table 1 also shows very little relationship between such demographic and socio-economic factors and survey responses. R (correlation)-values are generally low and/or insignificant. While the values were low, positive correlations between sex and the statements on the environment in question 1 were found in the case of those parts relating to the need to elicit positive transportation mode responses by raising fuel taxes and parking fees, the charging of extra fees for collecting more than one bag/can of household waste and the need to protect agricultural lands. Women were in significantly greater agreement with the relevant statements than men.

More significant relationships were found with respect to the various parts of question 2. Except for the part regarding willingness to invest in a programmable thermostat, all of the parts were negatively correlated with age, and the relationships of the highest magnitude were with respect to willingness to bike to work and compost kitchen and yard wastes. Willingness to move to denser housing, to switch modes of transportation to work in response to a doubling of gasoline prices and to bike to work if supplied with special lanes were negatively correlated with income (-.22, -.24 and -.15, respectively). Willingness to switch transport to work modes was also negatively correlated with community of residence and sex, although both relationships could also be expressed in terms of income.

Following age and to a lesser extent sex or income of respondent, political party support was significantly correlated with several of the substantive responses, although the highest and most consistent relationships were with respect to federal parties. Political parties were arrayed on the basis of total agreement or support with the parts of the two questions. Supporters of the Liberal Party, both federally and provincially, were most likely to support the statements made or behaviours most environmentally friendly. They were in turn followed by supporters of the New Democratic Party (NDP) and then the Progressive Conservative (PC) Party. Federally, responses of supporters of the Reform Party (RP) generally fell between those of the NDP and the PCs. Table 2 shows that, federally, significant negative correlations existed for those who agreed that recycling was the best contribution that individuals could make to mitigate environmental degradation and that more efficient cars should be a high priority. There was also a significant negative correlation between political party support and willingness to move to denser housing. Provincially, there was a negative correlation between political party support and the statement that recycling was the best contribution that could be made to reducing environmental degradation.

Municipal Spending Priorities and Concern for the Environment

Many municipalities, Winnipeg included, are finding it increasingly difficult to continue to provide existing service levels without raising property taxes or user fees. It may be anticipated that such a problem may be exacerbated during an economic recession when lower construction activity means lower total real property assessment increases, more often than not the source of revenue for service cost increases. Respondents were asked to choose one of four ways to responding to this situation: a) increase taxes and services; b) increase taxes as needed to maintain service levels; c) maintain tax rates and decrease service provision; and d) decrease both taxes and services. A minority of respondents chose either of the extremes. Two thirds said that they would prefer the maintenance of existing service levels with a corresponding tax increase, and only 13 percent said that they thought that existing service levels should be decreased to maintain taxes at their current rate.

As is shown in Table 3, respondents in agreement with the statements in question 1 were significantly more likely to support increased spending for various municipal services. Those strongly agreeing with the statement that public transport will present real alternatives to private cars only when accessibility and convenience are improved were significantly more likely to say that a lot more or somewhat more funds should be spent in the area of public transport ($r = .26$). And those who strongly agreed that the City of Winnipeg should devote greater effort to controlling sewer effluent were also more supportive of more spending on pollution control ($r = .19$).

Conclusion

Overall agreement with statements supportive of environmental action by Winnipeggers, as well as commitment to modify behaviour in response to modest changes in environmental parameters by Winnipeggers was high, consistent with a desire to mitigate environmental degradation. That this commitment appears to vary inversely with age is also a positive result of the responses to the 1992 Winnipeg Area Study (WAS).

However, the survey results also indicate that public education efforts to date may not have been entirely successful. Responses to questions related to mode of transport to work underlie an overwhelming commitment to the continued use of the private car as the principal mode of transport to work. And while context–the relationship between home and work–of many urban dwellers may not be conducive to convenient substitution of alternative transport modes, the ability and willingness of more affluent Winnipeggers to resist switching transport modes even in the face of doubling of gasoline costs is indicative of society's overall dependence on and commitment to the automobile. Even more significant as an indicator of the need for greater public education is the position of a vast majority of Winnipeggers to the proposition that they consider moving to denser housing forms or that they support planning and zoning efforts to introduce such forms into existing neighbourhoods.

NOTES

1. The Winnipeg Area Study Research Report No. 42 (June 1992), which may be obtained from the University of Manitoba's Department of Sociology, describes pretest results and procedures, interview techniques, sampling procedures, sample, representativeness and the quality of the interviews.

2. Cf. Linda Derksen and John Gartrell, *The Social Context of Recycling in Alberta* (Alberta/Edmonton Series Report 73; Edmonton: University of Alberta, Population Research Laboratory, 1991).

3. The City Council has authorized officials to locate recycling depots at or adjacent to regional shopping centres, but operators of these facilities are reportedly not keen to host the new function. In 1991, 53% of Manitoba households utilized recycling services available to them, compared to 86% for Canada, and 22% of all households recycled four common household wastes, compared to 42% for Canada. Cf. Statistics Canada, *Households and the Environment*, 1991, 1992. Catalogue 11-526 Occasional, Tables 1-4.

4. Cf. Cynthia Pollock, *Mining Urban Wastes: The Potential for Recycling* (Worldwatch Paper 76; Washington, DC: Worldwatch Institute, 1987).

5. Derksen, Social Context, pp. 5-7.

Jeffrey Patterson
Senior Research Fellow

SUSTAINABLE CITIES

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URBAN PUBLIC TRANSIT AND SUSTAINABLE CITIES

Canadians concerned about the quality of urban environments, and especially about the role of the transportation sector in degrading those environments, may have further cause for concern as a result of recent trends in public transit use. From 1986 to 1991 the number of annual total rides on Canadian urban public transit decreased by nearly 14%. Per capita *ridership for areas served decreased from 111 to 96. This decrease represents a major departure from trends prevailing throughout most of the previous two decades and appears to be nationwide in extent. Among major urban public transportation systems, decreases for this five-year period ranged from a low of five percent for Quebec to a high of 22% for Winnipeg.*

This issue of Sustainable Cities *explores the causes of this phenomenon, as well as potential implications for more sustainable urban development.*

Winnipeg Transit Energy Bus *Photo Credit: Winnipeg Transit*

Urban Transportation and Environmental Quality

Primarily as a result of its almost exclusive reliance on the combustion of fossil fuels, transportation contributes to the degradation of the air, land and water. The concentration of large populations and the density of transport in geographically small entities intensifies adverse impacts in urban centres. Some of the most significant impacts are on air quality.

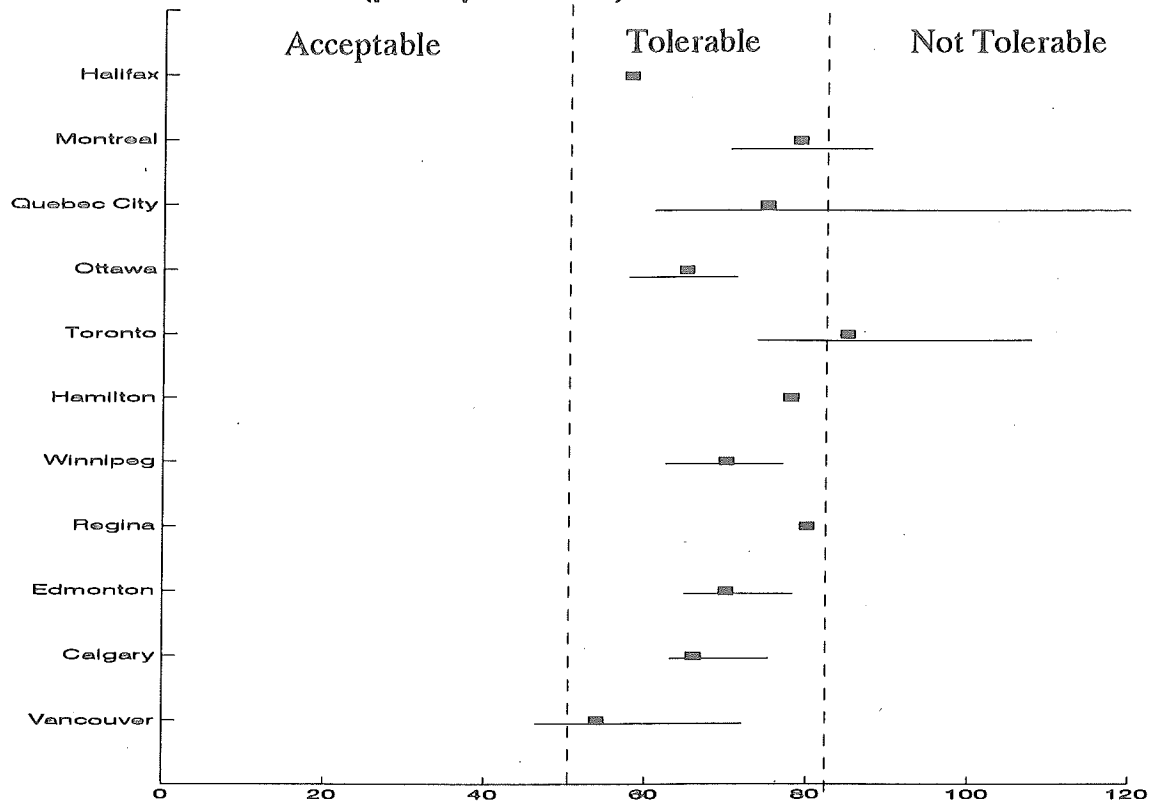
The atmosphere contains several discrete layers. From an air pollution perspective, the most important are that closest to Earth, the troposphere, and the stratosphere. High air quality in the troposphere is essential for thriving plant and animal life. Air quality is being compromised throughout the world by anthropogenic (human-generated) air pollutants, and many of these pollutants are generated in urban areas and/or by the transport sector.

In polluted air, sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO), particulate matter and organic gases and vapours are found at levels in excess of their natural levels of concentration. Many of these are toxic; that is, breathing in air with concentrations substantially above natural levels may be harmful to plant and/or animal life. Asthma, respiratory infections and changes in lung function, as well as chronic pulmonary disease, are attributed to toxic air pollution.[1] Injury to plant life has also been observed.

There are additional air pollutants not usually considered to be in the toxic category. Carbon Dioxide (CO_2) and methane (CH_4) are considered greenhouse gases because they influence the rate of heat loss from Earth, and chlorofluorocarbons (CFCs) and halons are referred to as ozone-destroying substances because they contribute to the depletion of the stratospheric ozone layer which is so essential in filtering ultraviolet (UV) radiation from the sun.

Transportation is also responsible for significant degradation of water and soil. Pollution results when vapours and aerosols precipitate in solution with water and when they are carried by storm water runoff. In addition, one observer attributes some 200,000 premature deaths annually to the production and use of energy, a significant proportion of which is for

Figure 1: Average of Peak Hourly Ozone Levels in Selected Cities (parts per billion) 1983-1987



Source: Environment Canada, *National Urban Air Quality Trends* (EPS 7/UP/3), Figure 12.

transportation.[2] As well, acidification of surface waters has occurred as a result of water borne-vapours and aerosols.

Urban transportation, and more precisely contemporary urban North America's excess dependence on the automobile, is also cited as a significant cause of numerous social and fiscal urban problems: noise; accidents and local traffic impacts; social isolation and locational inequity; and loss of the public realm in cities.[3] The Worldwatch Institute estimates that government subsidies for the automobile in the United States amount to over $300 billion per year, or $4.50 per gallon of gasoline.[4] Low-density sprawl is very expensive to service with both physical and social infrastructure. As well, provision for auto-based transportation is often responsible for as much as 30% of urban land use. This massive subsidy to the automobile in auto-dependent cities is only just beginning to be analyzed.

Transportation is associated with 20% of Canadian emissions of SO_2, 67% of emissions of CO, 64% of NO, NO_2, and ground-level ozone that is formed through the interaction of ultraviolet radiation from the sun and nitrogen oxides and volatile organic compounds.[5] Until its removal from the manufacture of gasoline, transportation was also responsible for a large proportion of air-based lead emissions. That fossil fuel combustion for transportation is responsible for such a large portion of toxic air pollutants and that the transport of passengers and freight is so concentrated in urban centres makes transport the main culprit with respect to urban-based toxic air pollution. Figure 1 portrays peak hourly ozone levels in selected cities. Four of the selected cities–Montreal, Quebec, Toronto, and Hamilton–frequently experience ranges of peak hourly concentrations above levels considered tolerable by Environment Canada.

The transportation sector is also associated with the emission of 31% of greenhouse gases in Canada, although the relatively non-toxic nature of these means that urban areas need not comprise the main focus for their reduction. The transportation sector's overall contribution is nevertheless significant. Reducing transport-based emission of greenhouse gases is crucial to achieving overall world targets for CO_2 reduction, and the ready existence of alternative transport modes in urban areas encourages emphasis on an urban solution.

Per capita emission of greenhouse gases in 1988 in five European cities participating in the International Council for Local Environmental Initiative's Urban CO_2 Reduction Project were 48% of those of seven participating North American cities, and the transportation sector was responsible for approximately 60% of the differential.[6] Transportation was responsible for 21% of all emissions in the European cities and 44% of emissions in the North American cities.

While changes in vehicle fleet performance–smaller size and more efficient combustion, together with other changes unrelated to transport systems, may be sufficient to permit

TABLE 1: PUBLIC TRANSIT PATRONAGE, URBAN DENSITY AND FARES, SELECTED CANADIAN CITIES

	VAN	CAL	EDM	REG	SAS	WPG	TOR	HAM	OTT	MTL	QUE	HFX
TRANSIT RIDES/CAPITA												
1945 (Gross)[1]	293	na	292	na	260	322	354	na	273	332	na	376
1965 (Gross)[1]	73	na	82	na	75	119	143	na	79	124	na	86
1986 (Gross)[2]	107	78	78	52	74	105	207	76	152	224	84	68
1991 (Gross)[2]	94	72	69	40	67	82	186	60	133	196	80	61
1965-1986 (% Change)	+46	na	-5	na	-1	-12	+45	na	+92	+81	na	-21
1986-1991 (% Change)	-12	-8	-12	-23	-10	-22	-10	-21	-12	-12	-5	-10
DENSITY, URBANIZED AREA (km^2)[3]												
1966 (Gross)	2140	2400	2380	2150	2000	2740	3000	2730	1970	4160	3140	2040
1986 (Gross)	1720	1140	930	1430	1700	1360	2900	2120	1550	2840	2400	870
1966-86 Change (Gross)	1280	730	550	710	1330	370	2750	1230	890	900	1530	420
FARE REVENUE/PASSENGER												
1965 ($)[1]	.17	na	.14	na	.14	.14	.16	.13	.16	.14	na	.11
1986 ($)[2]	.92	.74	.81	.63	.47	.52	.73	.78	.70	.53	.64	.75
1991 ($)[2]	.96	1.00	.96	.93	.63	.64	1.07	.96	.96	.68	.78	.98
1965-1986 (% Change- $ Current)	+441	na	+478	na	+236	+271	+356	+500	+338	+278	na	+582
1986-1991 (% Change)	+4	+35	+18	+48	+34	+24	+46	+23	+37	+28	+17	+31
1986-1991 (% Change- $ Current)	-22	+9	-8	+22	+8	-2	+20	-3	+11	+2	-9	+5

Sources:

1. N.P. Lea and Associates, *Urban Transportation Development in Eleven Canadian Metropolitan Areas,* Prepared for the Transportation Planning Committee, Canadian Good Road Association, 1966.
2. Canadian Urban Transit Association, *Canadian Transit Fact Book*, 1986 - 87 and 1991.
3. C. Leigh Warren and Paul C. Rump, *Urbanization of Rural Land in Canada, 1966 - 1976 and 1971 - 1976.* Ottawa: Lands Directorate Tables 1 and 6; Environment Canada, State of the Environment Fact Sheets, 85-4 and 89-1, and supplementary data from State of the Environment Report Branch.

Canada and the United States to restrain CO_2 emissions to their present levels over the period 1990 to 2000, the current target in *Canada's Green Plan*, the achievement of more ambitious targets, including the 15% reduction in 1988 emissions by the year 2005 agreed to at the first International Conference on Climate Control, would require reduced reliance on automobiles.[7]

The Place and Use of Urban Public Transportation

The benefits of providing and promoting urban public transit are usually identified as two-fold. Firstly, urban public transit has been viewed by transportation planners as reducing urban traffic congestion. Less reliance on individual motor vehicles reduces the requirement for costly investment in and operation of expressways, traffic lanes and car parks. It also facilitates the high density of residences and jobs that is often achieved in urban centres and major sub-centres. Increased physical mobility for disadvantaged groups is a related benefit.

A second benefit of greater urban public transit use, or at least of reduced automobile use, is reduced toxic pollution and greenhouse gas emissions. In the above-noted Urban CO_2 Reduction Project, emissions from the transportation sector in the five European cities were 16% of those in the North American cities. While significant proportions of this differential result from auto and truck fleet characteristics, shorter travel distances occasioned by greater urban densities and significantly greater use of bicycles and walking for work and other daily trips, greater use of urban public transit, often as many as 30% of all work trips, also contributes significantly to the differential. In 1991, approximately 15% of urban Canadians used public transit for work trips.

Table 1 identifies urban transit use in 12 Canadian cities for the period 1945 to 1991. The year 1945, which is still associated with war-time rationing, likely represents an all-time peak in urban public transit use. Unprecedented economic growth in the next two decades, also featuring growth in automobile ownership to approximately 70% of households, resulted in significant decreases in transit patronage. By 1965, rides *per capita* approximated 40% of 1945 levels in Toronto and Montreal and from 23 to 29% of 1945 levels in the remaining major urban centres.

The mid-1960s represent a significant threshold in the life of many Canadian urban transit systems. It also represents the end of the self-financing era for Canadian public transit. In 1965, fare box revenues comprised 100% of expenditures for the largest cities, and they even returned a profit to local councils in a few notable instances. In Western and Atlantic Canada, passenger revenues approximated 85% of expenditures for major cities.

By 1986 and the end of another two decades, rides *per capita* had reversed their steady declines experienced from 1945 to 1965 in the case of the three largest systems, increasing by over 80% in Montreal, by 45% in Toronto and also by 45% in Vancouver, which hosted Expo '86. Further decreases were limited in the case of most other major systems, 21% for Halifax being the greatest further decrease from 1965.

Most major Canadian cities placed greater priority on urban public transit and significantly less priority on road construction in this pivotal period than did cities in the United States. A mid-1960s study for the Canadian Good Roads Association concluded that Canadian cities were projecting 60 to 70% of the *per capita* rate of expressway construction of their American counterparts.[8] A large proportion of those projections never came to fruition. By 1980, approximately 15% of workers in major Canadian cities commuted by public transit, almost five times the level in major cities in the United States and greater than the proportion in many European countries.

By the early 1980s, fare box subsidies, both from local property taxes and from provincial transfer payments, approximated 50% of expenditures for most Canadian urban public transit systems. Provincial transfers comprised 58%, and municipal subsidies comprised the balance of the total subsidies in 1986. Public transit subsidies averaged 63% of total costs in the United States, and they ranged upwards to 78% in The Netherlands. Also during this period, increases in vehicle kilometres of service for Canadian urban public transit systems, partially as a result of the extension of systems into low-density suburbs, averaged over seven percent *per annum*, greater than for any other Western, industrialized country.[9] Per capita automobile registrations in this period increased by over 40% on the Island of Montreal and in Metropolitan Toronto, by over 60% in Vancouver and by over 100% in most other major CMAs.

As indicated above, data from the period 1986 to 1991 indicate a possible reversal of trends from 1965 to 1986. Decreases in *per capita* ridership were 10% in Toronto, 12% in Montreal, Ottawa and Vancouver, and they varied from five to 23% in the remaining eight cities monitored. The reasons for these decreases are explored below.

Transit and Urban Density

It is to be expected that the population density of an area served by a transit line plays a key role in determining patronage. Most of the market area of a transit line lies within close walking distance. Experience is that population density affects not only the number of people potentially available to use transit, but is also strongly correlated with the proportion of people that actually make use of it.

Figure 2 displays the relationship between urbanized area density and transit rides *per capita* for 12 major Canadian cities. The correlation is very strong in both 1966 ($r = .77$) and 1986 ($r = .72$) and significant (.98). While the correlation decreased from 1966 to 1986, urban area density continued to explain over 50% of variation in *per capita* transit ridership. The data also indicate a major change in the slope of the regression line. The importance of density in determining transit ridership levels increased significantly between 1966 and 1986. The major investment in public transit and expansion in areas served that occurred in most cities between the mid-1960s and 1980s may have resulted in the maintenance of ridership levels even in the face of significant urban area density decreases in Canadian cities.

The importance of density as a determinant of ridership levels is also amply demonstrated in the cases of those urban areas where suburban areas are served by separate transit systems. Table 2 shows that the two Edmonton suburban transit systems (St. Albert and Strathcona County) that serve suburban areas were used by 22

FIGURE 2

TRANSIT RIDES PER CAPITA BY DENSITY OF URBANISED AREA
1966 - 1986

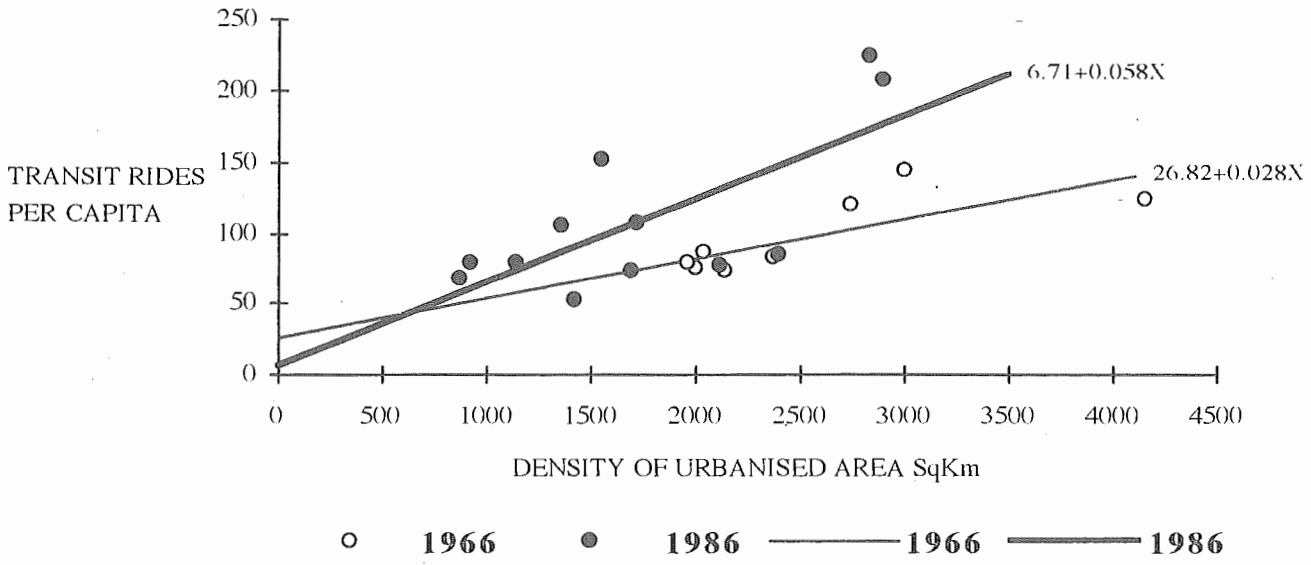


TABLE 2: SUBURBAN TRANSIT CHARACTERISTICS, 1991

	EDM	MTL	OTT	TOR
Rev. Pass./Cap.	22	79	50	45
Rev. Pass./Rev. Veh. Hr.	20	33	78	24*
Rev. Veh Hr./Cap.	1.1	2.4	1.6	1.1*
Total Cost/Rev. Pass.($)	2.44	2.85	2.99	3.99

* Excludes Go Transit

Source: *Canadian Urban Transit Fact Book*. 1991 Operating Data

passengers/*capita* in 1991, less than a third the average for the City of Edmonton. In the Toronto area, the 11 suburban transit systems, including the extensive GO Transit commuter bus and train system, were frequented by 45 passengers *per capita*, 24% of the level of ridership in Metropolitan Toronto. Suburban areas across the major rivers from Montréal (Rive-Sud de Montreal) and Ottawa (Outaouais) appear to be relatively better served. The number of revenue passengers *per capita*, revenue passengers per revenue vehicle hour of service and revenue vehicle hours of service *per capita* all more closely approximate those for the major city. Higher costs per revenue passenger on these suburban systems results in considerably lower productivity rates with respect to the service levels that are provided. Total costs per revenue passenger were 136% higher than for the primary transit company in Toronto (38% higher excluding GO Transit costs), 76% higher for suburban Montreal, 64% higher for suburban Ottawa, but only eight percent higher for the average of the two suburban Edmonton transit companies that provided only a basic level of service.

Urban area population density together with population and land-use characteristics comprise the demand side of the urban transportation equation. As was seen above, urban area density likely explains a half or more of the variance in urban public transit patronage in large Canadian urban centres. The incorporation of other aspects of demand–population, employment and land-use relationships–into overall demand/supply equations would likely explain a significantly greater proportion of overall variance in public transit patronage.

TABLE 3: TRANSIT USE AND PERFORMANCE INDICATORS, 1986 - 1991

	VAN	CAL	EDM	REG	SAS	WPG	TOR	HAM	OTT	MTL	QUE	HFX
Transit Rides/Cap (1986)	107	78	78	52	74	105	207	76	152	224	84	68
Gasoline/Hshld. (lit 1986)	842	935	1066	933	843	724	792	2120	769	590	2400	669
Density (1986-Pop/km^2)	1720	1140	930	1430	1700	1360	2900	.78	1550	2840	.64	870
Fare Rev/Pass (1986 - $)	.92	.74	.81	.63	.47	.52	.73	1.94	.70	.53	2.48	.75
Rev Veh Hr/Cap (1986)	2.96	1.78	2.82	1.52	1.67	2.34	3.95	34	30.8	4.06	50	2.11
Rev Veh Km/Cap (1986)	46	41	61	44	30	44	89	20	73	82	37	34
Rev Veh Km/Km^2 $ (1986-000)	62	47	35	39	51	59	81		67	77		21
% Change 1986-91												
Rides/Cap	-12	-8	-12	-23	-10	-22	-10	-21	-12	-12	-5	-10
Pass/Rev Veh Hr	+4	-7	-1	-13	-8	-17	-4	-22	-27	+6	+3	0
Rev Veh Hr/Cap	-16	-7	-+11	-10	0	-5	-6	+2	-6	-18	-8	-10
Rev Veh km/Cap	+26	+22	-15	-41	0	-4	-8	0	-27	-8	-6	-3
Employment	+34	+8	+10	+2	+2	+2	+2	+6	+11	+4	+6	+12
Operating Rev/Pass	+4	+35	+18	+48	+34	+24	+46	+23	+37	+28	+17	+31
Municipal Subsidy/Cap	+27	+19	+22	+50	+64	-23	+73	+81	+53	na	+37	+20
Provincial Subsidy/Cap	-7	-38	-20	-100	-100	+19	+41	+20	+33	na	+16	-28
% Change 1966-86												
Density	-20	-52	-61	-33	-15	-50	-3	-22	-22	-32	-24	-57

Sources: Canadian Urban Transit Association, Transit Operating Data, 1986 and 1991; Environment Canada, Lands Directorate

TABLE 4: CORRELATIONS: PUBLIC TRANSIT CHARACTERISTICS, 10 CITIES, 1966, 1986, AND 1991

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	transit rides/cap	1.000															
2	gasoline use	-.566	1.000														
3	density	.881	-.468	1.000													
4	fare rev/pass	-.129	.407	-.258	1.000												
5	rev veh hr/cap	.925	-.409	.748	.157	1.000											
6	rev veh km/cap	.890	-.224	.728	.072	.905	1.000										
7	rev veh km/km sq	.870	-.388	.867	-.187	.741	.727	1.000									
8	% change rides/cap	.233	-.032	.130	.338	.272	.152	.077	1.000								
9	% change pass/rev veh hr	.153	-.087	.254	.296	.306	.046	-.054	.401	1.000							
10	% change rev veh hr/cap	-.291	.180	-.207	-.414	-.464	-.304	-.086	.009	-.635	1.000						
11	% change rev veh km/cap	-.031	-.048	-.025	.327	.006	-.291	.081	.533	.488	-.112	1.000					
12	% change employment	-.125	.101	-.201	.775	.110	-.153	-.059	.261	.333	-.503	.535	1.000				
13	% change operating rev/pass	.136	-.180	.278	-.450	-.155	.147	.124	-.122	-.442	.459	-.494	-.691	1.000			
14	% change municipal subsidy/capita	.036	.284	.250	.114	-.013	.168	.126	.296	-.184	.398	-.275	-.081	.497	1.000		
15	% change prov subsidy/cap	.700	-.380	.361	.273	.776	.692	.585	.160	-.080	-.187	.114	.172	-.176	-.221	1.000	
16	% change, density 66-86	.512	-.201	.738	-.113	.381	.398	.710	.138	-.056	.170	-.043	.023	.344	.696	.118	1.000

Sources: 1) Environment Canada, Lands Directorate and State of the Environment Reporting Branch.
2) Statistics Canada, Family Expenditures, Canada, 1986.
3) Canadian Urban Transit Association.

Transit Operating and Performance Characteristics

Supply side characteristics are nevertheless important parts of the total equation. Transit operating and performance characteristics, summarized in Table 3, constitute the supply side of the equation. Table 4 contains the coefficient of regression coefficients for various transit supply and demand characteristics and performance indicators for 1986 for 12 cities. Among the variables with highest correlations with rides/*capita* are revenue vehicle hours/*capita* (r = .925), revenue vehicle km/*capita* (r = .89) and density (r = .881). While the correlation coefficient for the first two variables is extremely high and significant (r = .905), the correlation of either of these variables with density (r = .748 and .728) and with revenue vehicle km/km², a measure of transit route density (r = .737 and .723), indicates that individual transit companies, while limited by the demand characteristics of the geographical areas served, have exercised considerable latitude with respect to the level of service provided and that this supply of urban transit services has influenced the use of urban public transit. The data do not indicate that transit fares are an important variable in determining overall public transit patronage. Fares might be a more important factor with respect to short-term changes in urban public transit ridership, or alternative and more sophisticated analysis might show that their explanatory value increases following a period of adjustment by riders.

Summary of Determinants of Rides and Changes in Rides *Per Capita*

Table 5 summarizes the results from stepwise regression equations with respect to the determinants of transit rides *per capita* and changes in transit rides *per capita*, 1986-1991. The two most important independent variables with respect to transit rides *per capita* are, first, vehicle hours of service *per capita* and urban area density (combined r^2 = .919). While the inclusion of further variables in the combined equation does not appreciably improve explanatory power, some of

TABLE 5: REGRESSION RESULTS, TRANSIT READERSHIP, 1986, AND CHANGE, 1986 - 1991

Dependent Variable: Transit Rides/Capita, 1986		B	Beta	Partial Cor
Variables in Equation:				
5	Rev Veh Othr/Cap, 1986	40.10	.60	.40
3	Density, 1986	.04	.43	.28
Multiple R^2 = .937				
Variables Not in Equation:				
2	gasoline/hshld			-.53
4	fare rev./pass.			-.55
7	rev veh km/km^2			.42
9	% change, 1986-91, pass rev./veh. hr.			.59
12	% change, 1986-91, employment			.46
13	% change, 1986-91, oper. rev/pass			.56
15	% change, 1986-91, prov. subsidy/cap.			.56
Dependent Variable: % Change, 1986-91, Transit Rides/Cap				
16	density change, 1966-86	-.37	-1.44	-.62
12	employment change, 1986-91	-.92	-1.76	-.46
15	prov. subsidy/cap. change, 1986-91	.01	.09	.07
9	rev. veh. hr./cap., 1991	-.61	-1.2	-.34
2	hshld/gasoline, 1986	-.04	-.96	-.49
11	rev. veh. km./cap. change, 1986-91	.50	1.94	.61
13	open rev./pass change, 1986-1991	-.49	-1.38	-.43
10	rev. veh hr./cap. change, 1986-1991	-1.53	-1.59	-.41
14	municipal subsidy/cap. change, 1986-1991	.53	3.07	.69

Sources: Environment Canada, Lands Directorate and State of the Environment Reporting Branch. Statistics Canada, *Family Expenditures, Canada, 1986.* Canadian Urban Transit Association.

the remaining residual partial correlations are nevertheless interesting. While fare revenues per passenger were not an important determinant of overall ridership levels, they increase considerably in importance in explaining the residual variance (r = -.55), as do percent change in operating revenues per passenger and percent change in provincial subsidies per passenger (r = .56).

Variables identified with the change in rides *per capita* from 1986 to 1991 included change in urban density, 1966-1986 (partial r = .620), percent change in municipal subsidy/*capita* (partial r = .694), percent change in revenue vehicle kilometres of service (partial r = .614), and percent change in employment (partial r = -.458). The data contained in Table 3 tend to collaborate these findings. Regina experienced the largest decrease in numbers of *per capita* riders (23%). The change in vehicle kilometres *per capita* of service was–41%, by far the most extensive in Canada, and the change in employment from 1986 to 1991 was two percent, shared with three other cities and the lowest in the country. Winnipeg, which lost 22% of its *per capita* ridership from 1986 to 1991, also experienced a very low rate of employment growth (2%) and a relatively high density decrease (-50%). Toronto experienced a similarly low growth in employment during this five-year period, but its density decrease had been the lowest among the major cities, and its municipal subsidy increases (46% *per capita*) ranked second among the 12 major transit systems. The relative decrease in public transit ridership was less than for all but two of the cities included herein.

Conclusions

Urban transport systems are crucial to local degradation of the troposphere, urban water and soil pollution and the emission of greenhouse gases. The purposes of this brief paper included identification of the links

between air pollution and urban transportation, the place of urban public transit in mitigating urban environmental degradation, and the determinants of urban transit ridership levels and changes in those levels. While the results should not be viewed as conclusive, they nevertheless provide tentative insights into the underlying importance of urban form and density and of the importance of transit supply in determining ridership levels and changes therein.

High levels of public transit patronage, however, do not necessarily translate into environmental quality or lower pollution levels. Newman and Kenworthy note that Metropolitan Toronto, which possesses one of the highest rates of public transit use for work trips of any city in the world, still experiences a level of *per capita* gasoline consumption that is well within the North American norm.[10] North American auto and truck fleet characteristics are cited as one reason. Urban density is also a variable in the length of trips and in the decision to walk or cycle with respect to both work and non-work trips, and it may also be the low levels of walking in Canadian and North American cities that ultimately determine the intensity of transport energy use.[11] Urban public transportation is nevertheless critical in mitigating environmental degradation. Increased urban area densities are critical for both public transit use and walking and cycling.

Despite decreasing urban densities Canadian urban public transit systems were able to maintain and often even improve ridership levels up through the early 1980s. The key to this experience appears to have been the willingness to subsidize urban public transit expansion by both municipal and provincial governments. Montreal's Metro was opened in this period. Light rail transit systems were initiated in Calgary, Edmonton and Vancouver, and a similar "bus way" system was implemented in Ottawa. Total kilometres of service increased by over seven percent annually from the mid-1960s to the early 1980s. From 1966 to 1986, urban public transit moved from a break-even service of Canadian municipalities to one in which half of costs were raised other than from the fare box.

The late 1980s witnessed indications that urban public transit, in addition to the always present pressures occasioned by declining productivity and of serving cities of decreasing density with public transit, was losing the support implicit in these earlier public decisions. Extreme examples are in Regina and Saskatoon. Saskatchewan became the first provincial government to terminate subsidies. Overall, provincial subsidies decreased from 58 to 49% of the combined provincial-municipal total.

Service level decreases became the norm in this period, ranging from nil in Hamilton and Saskatoon to 41% in Regina. Of the major urban public transit systems, service increases occurred only in Calgary and Vancouver. Light rail transit expansion occurred in both of these instances. In short, the same limitations impinging on other municipal and provincial services are also affecting the willingness of municipalities to maintain public transit service levels.

Local government leadership in two separate domains will be required if the trends prevailing since the mid-1980s are to be altered. The most critical are decisions with respect to urban densities and land use. Of course, while the locus of formal decisions in land-use planning generally lies with municipal councils, those councils are in turn influenced by public opinion. And public opinion has on the whole been opposed to increased densities, both in particular instances where changes in land-use plans and zoning are requested and in general. The greatest success in this respect thus far has been in obtaining local council approvals for urbanization of fallow lands and re-urbanization of lands currently used for other purposes. The critical nature of the link between land use and transit supply decisions cannot be emphasized sufficiently. There is little doubt that some public transit investment decisions have been less than optimal as a result of the failure to make the link.

The second domain is that of public transit subsidization. As was noted above, urban public transit in most nations is subsidized to a greater extent than in Canada. The expectation that the fare box should generate 50 to 60% of costs, which has guided public transit decision-making for practically the last quarter of a century in Canada, may have to be altered. Many local councils accept the proposition that local property taxes are a legitimate source of local road and street subsidies, but they appear far less willing to accept the notion that urban public transit investment, one of whose results may be a diminished demand for road investment, is a legitimate public investment. Among public transit systems, only B.C. Transit in Vancouver currently has its own access to gasoline tax revenues.

Provincial requirements play a major role with respect to both policy domains. They are generally responsible for the planning framework within which local councils make decisions, and they are critical with respect to subsidizing public transit or authorizing municipal access to revenue sources other than local property taxes.

There is little doubt that new public transit investments are cost effective. A recent study of the economic effects of investing in rehabilitation and continued operation of SEPTA (Southeast Pennsylvania Transit Authority/ Philadelphia) *versus* cutting or even eliminating its services found that for every dollar of public spending, three dollars would accrue to its state and region as a result of improved transport.[12] A 1990 study of the Greater Toronto Area concluded that an alternative future "centralized" development scenario relying heavily on new public transit facilities would entail public capital investment costs similar to a scenario characterized as "continued sprawl," but would ultimately save over $2 billion in private user costs. Projected additional transit operating subsidies of almost $250 million annually in 2011 would be partially offset by reduced school bus subsidies of $100 million and reduced handicapped transit subsidies of $35 million annually.[13]

Prepared by Jeffrey Patterson, Senior Research Fellow, with Dorota Budziszewska, Christian Douchant and Herb Koehl, Student Research Assistants.

Notes

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This conference is endorsed by the World Conservation for Nature (IUCN), WWF (Canada), Man and the Biosphere Program (Canada), The George Wright Society, Science and the Management of Protected Areas Association, and Environment Canada.

Persons interested in presenting a paper or poster should submit an abstract no longer than one double-spaced typewritten page by October 30, 1993 to Mr. Neil Munro, Director, Policy Planning and Research, Environment Canada, Canadian Parks Service, Historic Properties, Upper Water Street, Halifax, Nova Scotia, Canada B3J 1S9 or Fax (902) 426-7012.

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SUSTAINABLE CITIES

ISSUE ■ NO. 7 IUS NEWSLETTER SUPPLEMENT DATE ■ AUTUMN 1993

SUSTAINABLE CITIES AND SETTLEMENT OF THE URBAN COUNTRYSIDE

A large body of literature in several academic disciplines and spanning several decades has focused on the urban succession of rural and agricultural land uses and communities at the periphery of our cities. What is variously called the urban or rural fringe because it is in the process of urbanizing or because it may currently possess the characteristics of a rural area, or the urban/rural fringe, acknowledging that fringe areas may be both urban and rural at the same time, is the geographic focus of this literature. Geographers have focused primarily on resource and land-use changes attending this process. Sociologists have focused extensively on the relationship between old and new residents. Political scientists have focused on the impact of fringe residents on the politics of the older city, as well as the nature of the new suburban or exurban politics. Public administrators focus on the impact of new residents on public finances and administration. Of course urban planners and designers focus on the design of new communities that are accommodated, most frequently on green fields.

Issues associated with designing cities in greater accordance with sustainable development principles include the impact of urban development and redevelopment on the quality of land, air and water resources, the most important consideration being any effect on carrying capacity of the ecosystem. The principal focus of those concerned with sustainable urban development has been on suburban development at the periphery of cities where the sustainable development interest has focused on the nature of additions to the urban fabric. Issues have included the density of new development, the proximity (or lack of it) of home, work and other major destinations of urban dwellers, and the proximity of different land uses to one another.

Travel is a major focus because it is based on extensive combustion of fossil fuels. Oil combustion for transportation is often responsible for well over 60% of some ground-level toxic air pollutants, such as oxides of nitrogen and ground-level ozone, as well as up to a third of CO_2 emissions that present a future substantial risk of global warming. It is commonly observed that in the dense inner cities of places as diverse as Montreal, Toronto, Vancouver and Winnipeg, some 20% of all trips are by bicycle or walking, another 35-40% by public transit and approximately 40% by car, whereas the proportion of trips by car approximates 75-80% in many suburban areas, and fewer than 10% of all trips are by bicycle or walking. For all of the above reasons, as well as for social reasons, compactness and diversity are valued as normative principles underlying sustainable development of cities.

Much of the focus on the nature of and ecosystem impact of development at the periphery of the city fails to distinguish between the dominant suburban development that is contiguous to the previously built-up city and non-contiguous or scattered development that occurs outside of the urban and urbanizing area in the urban/rural fringe. The latter is often neglected by those interested in steering our cities in more sustainable directions.

Sustainable Urban Development and the Urban/Rural Fringe

One of the foci of the Institute of Urban Studies' research program on sustainable urban development has been the settlement by urban dwellers of the urban/rural fringe. The recently released research and working paper, *The Prairie Urban Countryside: Urban/Rural Fringe Development in Prairie Regional Cities*, explores the issues empirically in the five largest Prairie cities of Edmonton, Calgary, Winnipeg, Saskatoon and Regina (in descending order of size).

Despite the realization of ambitious annexation schemes that accounted for over half of all territory annexed to central cities of Canadian Census Metropolitan Areas (CMAs) in the quarter century between 1966 and 1991, approximately one fifth of the population growth in these five regional cities located in the urban/rural fringe outside of their rapidly expanding city limits. Urban dwellers in Prairie cities, as do their counterparts in other regions of the country, see the urban/rural fringe as an extension of the suburbs and a legitimate residential opportunity. Approximately one half of these additional people, or 10% of the total population increase, resided in villages, towns and hamlets in 1991. The other half were dispersed more evenly in rural residences throughout the inner parts of the rural municipalities that surround the five regional Prairie cities.

Resources and the Development of the Urban/Rural Fringe

As is depicted in Figure 1, the precise residence decisions of these urban/rural fringe dwellers have important implications for the allocation of land resources. The extent of land transformed from rural to urban use per 1000 new popula-

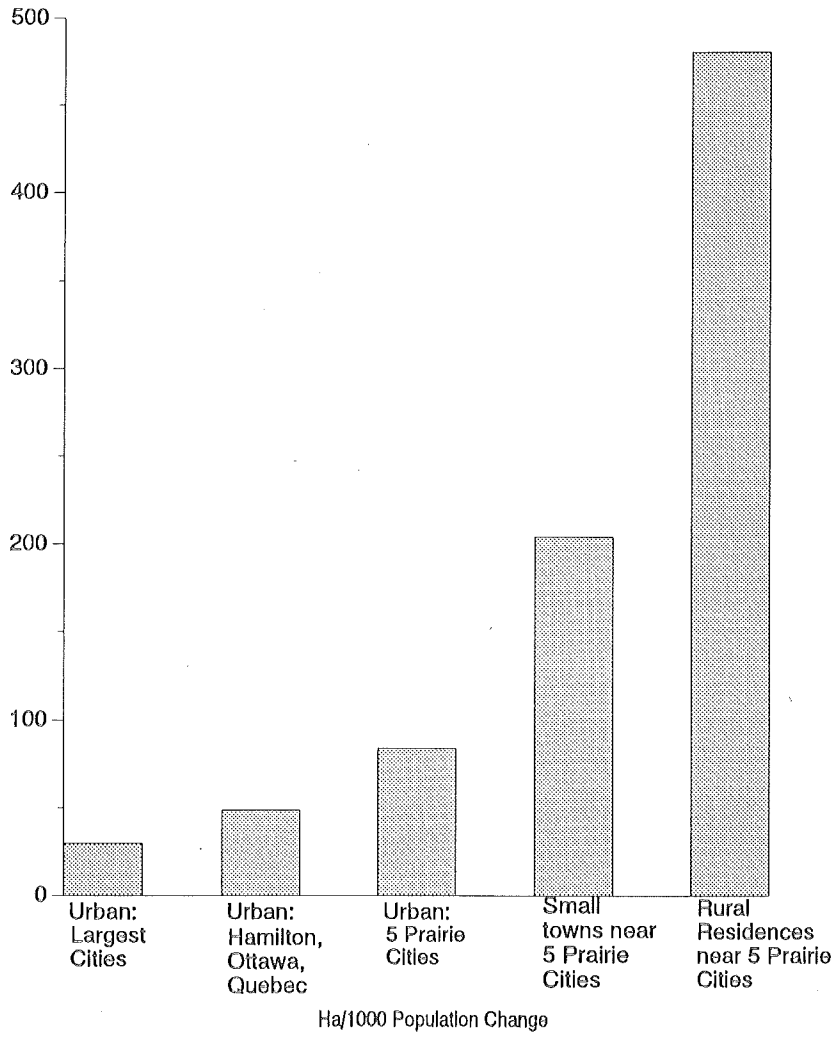
tion in the suburban areas of the five cities (84 ha/1000 population increase) was less than one half of that transformed for the small towns and hamlets (204 ha/1000 population increase), while the latter was again less than half the extent of land used for expanding countryside populations (481 ha/1000 population increase). It is these country residences that are most identified with major losses of farmland and often with "suburbanization" of the rural landscape.

Viewed from the perspective of resource use, the one fifth of new urban dwellers living in the countryside, also sometimes known as exurbs, consumed as much farmland as that lost to new suburban housing in the expansion of the central cities. Exurban development, and even more so, suburban development, have generally been oblivious to the quality of agricultural land used or to the existence of wetlands or woodlands, both among the fastest disappearing of rural land uses in the vicinity of Prairie cities. The location and pattern of development of country residences have often hindered the efficiency of remaining farm operations and future urban growth alike. As a result of considerable reliance on septic systems and the accompanying pollution of streams and groundwater, degradation of water resources is also more likely identified with exurban development. Increased development may also deplete shallow aquifers. Exurban development is almost completely identified with automobile dependence and much greater *per capita* emissions of greenhouse gases to the atmosphere than typical low-density suburbs at the edge of the city. Whereas up to 80% of all trips by residents of new suburbs are taken by private automobile, about 95% of trips in exurbs are made by car. The remaining five percent are usually by walking or biking. Work trips, many to downtown locations, are typically twice as long in duration and three times the distance of urban work trips.

Table 1 details intensity of land use and loss of farmland for the five regional Prairie cities. The data reveal several notable features of the relationship between resource use and urbanization, detailed to a greater extent in *The Prairie Urban Countryside*. First, we do not understand all of the reasons that might occasion either the removal or addition of farmland to the total inventory. Removal of farmland over the 20-year period from 1966 to 1986 was approximately twice that used for urban development. Additions, most in outlying parts of the relevant city regions, approximated three fourths of removals in Edmonton and almost one fourth of removals in the Winnipeg region. There were fewer additions in the other three cities, where land removed for urbanization and residential purposes in the urban/rural fringe more closely approximated removals from farmland in the Census of Agriculture. Secondly, the use of rural land for country residential purposes that accommodated no more than one tenth of population growth for the period approximated three fourths of all land used for additions to urban areas. The latter accommodated 80% of additional population in the period, as well as non-residential uses associated with urbanization. Land added to the jurisdictions of the small towns and hamlets surrounding the major cities was about 30% of that used for additions to the urban centres.

Table 2, which summarizes farmland losses and gains for the five-year period from 1986 to 1991 and those for the previous two decades, adds further emphasis to the randomness of overall gains and losses through time. The regions of two of the cities, Regina and Saskatoon, experienced gains in the 1986 to 1991 period, although they had experienced losses in the previous two decades. Net losses in the shorter period in the Edmonton region were almost four times those in the longer period.

FIGURE 1: INTENSITY OF LAND USE/1000 ADDITIONAL RESIDENTS, 1966 - 1986



Sources: 1) Canada, Census of Population, 1966 and 1986.
2) Environment Canada, Land Use Monitoring Program and State of the Environment Reporting Branch.

Table 1

FARMLAND LOSS, URBANIZATION AND COUNTRY RESIDENCES, PRAIRIE CITIES, 1966-1986

	Farmland, 1966-1986			Urban Expansion 1966-1986[2] (Ha)	Small Town Growth (Ha)	Rural Municipal Country Development		
	Removed (Ha)	Added (Ha)	Net Loss/Gain[1]			Net Dwelling Additions[3]	Country Residences[4]	
							No.	Ha
Edmonton	60,606[5]	44,834	(15,772)	25,870	10,780	17,453	11,500[6]	7,750[7]
Calgary	87,763	4,463	(83,300)	18,354	6,400	4,896	2,500[8]	18,750[9]
Winnipeg	49,099	11,650	(37,049)	11,046	na	9,670	5,006[10]	9,340[11]
Saskatoon	23,753	5,094	(18,659)	3,693	990	1,505	650[12]	10,400[13]
Regina	14,777	9,227	(5,550)	3,090	800	530	na	na
Prairie Cities	235,998	75,268	(160,330)	62,053	18,970	34,054	19,656[14]	46,240[14]

[1] Figures in parentheses indicate loss. Source: Census of Agriculture, 1966 and 1986.
[2] Source: Environment Canada Land Use Monitoring Program.
[3] Census Canada (Net).
[4] Local estimates of approved parcels; some still undeveloped in 1986.
[5] Gains in City of Edmonton (37,598 ha) as a result of annexation in 1981 have been subtracted from losses in Strathcona and Sturgeon Counties.
[6] Approved parcels in 1984.
[7] Development as at 30/12/83. Residences for additional parcels occupying 15,500 ha approved but not developed.
[8] 1986 estimates by Calgary Regional Planning Commission.
[9] At 7.5 ha/country residence.
[10] Large lots created 1976-1988.
[11] Assumes average parcel size of 1.4 ha for country residences and .5 ha for non-country residences.
[12] Thomsen, 1978.
[13] Average parcel size of 16 ha. Cf. Thomsen, 1978.
[14] Excludes Regina.

Table 2

FARMLAND LOSS & POPULATION CHANGE, PRAIRIE REGIONAL CITIES 1966 - 1991

	EDMONTON	CALGARY	WINNIPEG	SASKATOON	REGINA	PRAIRIE REGIONAL CITIES
Net Farmland Loss (Gain)						
1966 - 1086 (ha)	15,772	83,306	38,033	18,658	5,549	161,318
1986 - 1991 (ha)	57,137	14,462	11,871	(6,483)	(20,175)	56,518
Region Population Change						
1966 - 1986	325,075	341,190	107,962	71,751	48,329	894,307
1986 - 1991	55,521	85,504	29,311	9,358	5,171	184,865
Farmland Loss (Gain)/1000 Pop Increase						
1966 - 1986 (ha)	48	244	352	206	115	180
1986 - 1991 (ha)	1,029	169	405	(690)	(3,879)	306

Sources: Canada, Censuses of Population and Agriculture, 1966, 1986 and 1991.

The Demand for Living in the Countryside

The demand for space by urbanites appears to be insatiable. The 1991 survey of residents of ten Canadian cities, including the five Prairie regional cities, by the Angus Reid Group and the Institute revealed that the proportion of residents wanting to move to suburban locations far exceeded those desiring to move in the opposite direction (see *Sustainable Cities*, 1, 1991). While a smaller proportion of residents in the Prairie cities than in the five non-Prairie cities expressed a desire to live outside the built-up urban area, almost one half of residents said that they were attracted by the prospect of living in the countryside or a village or hamlet outside the city, and half of these said that there was a high likelihood of realizing this desire in the next five years.

The characteristics of those living in the urban/rural fringe in 1986 are reviewed in *The Prairie Urban Countryside*. Among the features that distinguish urban/rural fringe residents is their domination by younger-than-average aged, child-rearing, coupled and affluent families with 30-50% more young children than the average suburban family. Median incomes in fringe areas, more so among the more dispersed settlers in the rural fringe, were well above those in the central cities. Being affluent, the incidence of poverty in rural municipalities was usually significantly less than the average for central cities.

Planning in the Regions of Prairie Cities

Promotion of sustainable urban development obviously requires increasing attention to planning in the city's countryside. Increasing attention by provincial and local officials to the issues presented by settlement of the countryside by urbanites did occur as time progressed during the past quarter of a century. Policies in effect in the 1980s showed considerably greater sensitivity to these issues than those existent in the 1960s when the move to the exurbs began in earnest. The current expectation is that large-city municipal authorities in each of the city regions will plan for most future urban growth on lands contained within municipal boundaries. Planning is moving towards what may be characterized as a comprehensive-integrated approach (Bryant and Johnston, 1992). Both Regina and Saskatoon have undertaken the development of joint plans with their surrounding rural municipalities. Regional planning commissions in both Calgary and Edmonton have negotiated planning agreements and commitments from the surrounding rural municipalities. While Manitoba terminated the City of Winnipeg's extra-territorial jurisdiction in 1989, that province is currently preparing a land-use plan for the "capital region" under the auspices of the Round Table on Environment and the Economy.

It is nevertheless evident that the task is made particularly difficult by the desire to accommodate a full range of residential choices, by the desires and needs of the farming community, and by competing policies and needs of the rural and urban municipalities in city regions. The same rural municipal authorities charged with conserving the countryside are also balancing the provision of urban services and property tax revenues.

Altering Residential Location Incentives

While improved planning systems will likely result in improved planning

Table 3

PER CAPITA TAXATION AND EXPENDITURES IN WINNIPEG AND RURAL MUNICIPALITIES, 1991

REVENUES	RURAL MUNICIPAL RING ($)	WINNIPEG ($)	DIFFERENCE	
			($)	(%)
Assessment	18,964	16,901	-2,063	
Tax revenues	661	1,106	+445	62.1
Non-tax revenues	158	429	+271	37.8
Total Revenues	819	1,536	+717	100
Expenditures				
Education	440	514	+74	10.3
Debt charges	13	156	+143	20.0
General Government	71	119	+48	6.7
Protection	28	234	+206	28.8
Transportation	149	168	+19	2.6
Welfare	6	92	+86	12.0
Recreation and Culture	8	128	+120	16.8
Other	24	64	+40	5.6
Total	820	1,536	+716	100
Non-education	380	1,021	+641	89.5

Source: Manitoba Rural Development *Municipalities of the Province of Manitoba, 1991.*

practice and development results, these systems can not overcome the problems of lack of political will or lack of intergovernmental co-operation that have been identified so many times previously as major reasons for the failure to realize planning goals and objectives. Many observers believe that sustainable development practices will occur only as the incentives to husband resources are applied. A public policy challenge is the generation of an economic environment that is conducive to ecologically sound decisions.

Two examples are illustrative. In the Winnipeg region, as shown in Table 3, property taxation levels obviously favour decisions to locate in rural municipalities outside the city. Municipal services spending other than for education in the ten rural municipalities surrounding the city approximated only 37% of spending levels in the city in 1991. Over 75% of the differential was accounted for by spending on debt retirement, protective services (principally fire and police), welfare services and recreation and culture. Many of these differentials stem from the decision by exurbanites to forego many municipal services or a community decision that certain services are not required. Many other differentials, however, stem from the provision of services or subsidies by the provincial government. There is a need critically to review service systems and methods of paying for them. Tax revenues for both municipal and school purposes in the rural municipalities were 3.5% of assessment, while they were 6.5% of assessment in the City of Winnipeg.

Some observers believe that charging urban transport system user fees or charges more closely approximating the true costs of providing services would reduce system use or requirements. A recent report by the World Resources Institute in the United States documents the fact that the road system cost (both urban and rural) is at least six times current user fees contained in road tolls and gasoline and diesel fuel taxes (McKenzie *et al.*, 1992). Road construction, repair and maintenance spending not covered by user charges in 1989 were two times those charges. The costs of providing parking for employees, which is not taxed in either the U.S.A. or Canada, was almost another two times current user charges. And external costs, including the health costs of ground level air pollution, the costs of meeting the U.S.A.'s commitment to keep CO_2 emissions constant, noise costs, accident costs not covered by insurance and security costs, were of similar magnitude. While current user charges in Canada are typically higher than those in the U.S.A., similar Canadian studies would undoubtedly produce similar estimates.

There is little doubt about the continued existence of demand for living beyond the built-up city by urbanites. New house construction in the rural municipalities surrounding Winnipeg was higher relative to the central city in the five years between the 1986 and 1991 Censuses than it was in any previous quinquennial period since 1966. In both Calgary and Edmonton, ambitious annexations by the central cities have masked demand for rural living, but the Calgary Regional Planning Commission nevertheless reported in 1993 that rates of rural parcel registration had increased dramatically since 1987 and that they were higher in 1990 than for any previous year since 1971 (Calgary Regional Planning Commission, 1993). They also reported that they felt rapid population growth in the 45-54 age group was one of the driving forces behind growth in demand for rural living. The demand for rural living among residents of the two smaller cities, Regina and Saskatoon, is less certain.

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Prepared by Jeffrey Patterson, Senior Research Fellow, with Herb Koehl, Research Assistant.

For more information on this topic, see the announcement of the publication of *The Prairie Urban Countryside: Urban/Rural Fringe Development in Prairie Regional Cities* by Jeffrey Patterson (1993) on p. 7, *IUS Newsletter.*

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Enid Slack for the Intergovernmental Committee on Urban and Regional Research. 1993. 60 pp., $12.50 + 0.88 GST.

While a number of studies have been done on the fiscal impact of different types of land use, little has been written on the impact of alternative financing techniques on land use. This discussion paper helps to close the information gap by examining the impacts of three current municipal revenue sources: user fees, property taxes and development charges as well as two potential sources: site value taxes and land value capture taxes.

2. Population Distribution and the Management of Urban Growth in Six Selected Urban Regions in Canada

Christopher R. Bryant and Daniel Lemire for the Intergovernmental Committee on Urban and Regional Research. 1993. 193 pp., $20.00 + $1.40 GST.

Authors Bryant and Lemire examine patterns of population change and urbanization in six of Canada's urban areas: Halifax, Montreal, Calgary, Toronto, Winnipeg and Vancouver. Impacts on land use and infrastructure are documented and regional and municipal government responses to urban growth are identified.

3. Environmental Policy Review of 15 Canadian Municipalities

Paule Ouellet for the Intergovernmental Committee on Urban and Regional Research. 1993. 2 volumes: Vol. 1: Summary Report (68 pp.); Vol. 2: Appendices (207 pp.). Both volumes: $25.00 + $1.75 GST.

How are municipalities progressing in their attempts to address pressing environmental issues? This two-volume report seeks to answer this question through an examination of plans and programs from 15 Canadian municipalities. Each plan or program is analyzed to determine the presence, or absence, of environmental policies in the following areas: air quality, water quality, solid wastes, hazardous wastes, land use, energy and transportation, environmental impact assessment.

4. Municipal Consolidation in Canada and its Alternatives

Allan O'Brien for the Intergovernmental Committee on Urban and Regional Research. 1993. 119 pp., $20.00 + $1.40 GST.

This study examines how Canadian provincial governments have approached the restructuring of municipalities over the last decade. The author looks at alternatives to consolidation, provides a national overview of municipal government organization and presents case studies of municipal amalgamation and restructuring.

5. Canada's Aging Rural Population: The Role and Response of Local Government

Gerald Hodge, with Lauri McKay and Pierre Beeckmans for the Intergovernmental Committee on Urban and Regional Research. 1993. 43 pp., $12.50 + 0.88 GST.

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The conference will provide an opportunity for academics/researchers in urban-related fields from across Canada to present papers relevant to the interdisciplinary field of Urban Studies, including, for example:

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- urban government/politics
- quality of urban life
- urban housing
- urban ecology/biology
- urban health
- urban transportation
- urban design
- urban heritage

Academics attending the Learneds for meetings of their own societies, as well as those in disciplines not normally represented at the Learneds, are encouraged to attend, and to submit proposals for presentations.

It is hoped that this conference will be the first step towards the formation of a Canadian urban studies association, and a meeting to discuss this possibility will be scheduled for the conference.

Deadline for submission of 250-350 word abstracts is November 30, 1993.

Proposals for conference papers should be submitted to Dr. Mary Ann Beavis, Institute of Urban Studies, The University of Winnipeg, 515 Portage Avenue, Winnipeg, Manitoba R3B 2E9. Tel. (204) 786-9851; Fax (204) 786-1824.

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SUSTAINABLE CITIES

ISSUE ■ NO. 8 IUS NEWSLETTER SUPPLEMENT DATE ■ WINTER 1994

WASTE MINIMIZATION IN THREE MAJOR PRAIRIE CITIES

One of the major responsibilities of Canada's municipalities is the collection and/or disposal of solid waste generated by residents and businesses within their boundaries. A variety of factors make waste minimization (reduction, re-use, recycling, and recovery) one of the most substantial ways in which municipalities contribute to the objectives of sustainable development and of Canada's Green Plan. This issue of Sustainable Cities reviews the waste minimization activities of the three largest Prairie cities, Calgary, Edmonton and Winnipeg.

Environment is generally considered to be a shared jurisdiction between the federal and provincial governments. Provincial governments are generally responsible for the quality of the environment within their borders. Municipalities play an increasingly crucial role in environmental protection within frameworks provided by the provinces. Municipalities are critical elements in any waste reduction strategy. The growing shortage of disposal opportunities, growing citizen opposition to the development of new landfill and incineration sites, and dramatically increasing costs of developing environmentally acceptable facilities have added to the impetus for greater emphasis on waste minimization.

Increased environmental awareness of the impact of waste disposal on the environment, as well as an increased scale and magnitude of impact attendant to growing population and increased waste generation, have also resulted in increased provincial regulation of municipal waste disposal activities. Provinces increasingly require that landfill gases from current and previous landfills must be monitored and limited where there are potential harmful impacts. Leachate emissions, the liquid waste that is invariably emitted from disposal sites for wet waste, must be contained on site or treated in sanitary waste management systems.

In 1989 the Canadian Council of Ministers of the Environment, which includes all of Canada's ministers of the environment, set a nationwide goal of 50% reduction in the per person weight of garbage sent for disposal by the year 2000. Although different provinces will have varying capability of achieving this target, each province is committed to this degree of reduction. Several provinces have set interim targets as well. British Columbia is committed to reducing *per capita* garbage weight by 35% by 1995.

Just as importantly, public opinion points toward increased popular expectations of municipalities with respect to waste minimization strategies. In the autumn of 1991, residents of eight large cities, when asked by the Angus Reid Group to indicate the priority they placed on a variety of urban initiatives, ranked developing better programs for solid waste reduction and recycling a close second to reducing crime as a municipal priority.[1]

Improved recycling was only slightly less important to the residents of the three Prairie cities. It ranked a strong third to reducing crime and promoting economic development. Seventy-four, 70 and 67% of respondents in Edmonton, Calgary and Winnipeg, respectively, indicated that waste reduction scored 6 or 7 as a future municipal priority on a scale of 1 to 7. Sixty-nine percent of respondents in the 1992 Winnipeg Area Study, an annual public opinion survey of Winnipeg residents by the University of Manitoba's sociology department, agreed that reducing, re-using and recycling waste was the most important thing that they could do for the environment. Only the need for further efforts to purify sewage effluent entering Winnipeg's Red and Assiniboine Rivers–73%–exceeded reducing and recycling waste as a priority among Winnipeggers.[2] In a similar survey administered from the University of Alberta's Population Research Laboratory in 1990, approximately 89% of respondents in both Calgary and Edmonton said that they were concerned or very concerned about Earth's environment, and 59 and 72%, respectively, said that they recycled either old newsprint and/or bottles and cans.[3] That varying proportions of the two city's populations recycled despite similar levels of agreement on the importance of protecting the environment was attributed to respective recycling opportunities in the two cities.

Waste Minimization and Sustainable Development

Waste minimization contributes substantially to sustainable development objectives, and the further up the sequential hierarchy of reduce, re-use, recycle, recover that waste is minimized, the greater is the benefit. Generally, reducing, re-using and recycling products decreases the total demand for limited natural resources and energy consumption in manufacturing.

Recycling a glass jar saves enough energy to light a 100-watt light bulb for four hours. Recycled paper uses up to 64% less energy to manufacture than virgin paper and produces only one-half the ground level air pollution and surface water degradation.[4]

Waste minimization also makes economic sense to both cities and consumers. The cost of municipal waste disposal increased more in the 1980s than the price of oil did in the 1970s. Nearly $1 of every $10 spent for food and beverages pays for packaging.

Waste disposal also emits considerable pollution and greenhouse gases (GHGs) into the atmosphere. GHGs are implicated in the potential for global climate change and its likely impact on the biosphere. One quarter of landfill gas consists of CO_2. Methane from landfills contributes 49% of anthropogenic (human-produced) methane in Canada. Methane is potentially explosive, should it find its way from landfill sites into buildings. An increasingly common practice is for methane to be flared (burned) on site so that it does not enter the atmosphere, and it is sometimes used to produce power and heat. Other toxic and nuisance gases may be emitted by landfill sites as well.

Incineration of garbage, the method used to dispose of approximately eight percent of Canada's municipal waste, reduces pollution caused by the leakage of gases from landfills, but it results in the emission of other toxins into the atmosphere. Ash and fly ash from incinerators also contain a number of harmful organic (dioxins, furans and PAHs) and inorganic (cadmium, chromium, lead, mercury and zinc) chemical substances. However, incineration, combined with district heating, a common practice in many European cities, can reduce substantially both the total demand for heating the built environment and the accompanying greenhouse gas emissions. Despite its potential for energy recovery and the fact that incineration reduces waste weight by 85%, incineration is now a declining disposal technique in Canada. Locating incineration sites also invariably produces the same opposition as locating new landfill sites.

Minimization of Waste and Municipalities

Municipal solid waste generally includes residential, commercial, institutional and light industrial waste. These wastes totalled 21 million tonnes in 1988, and 16 million tonnes (76%) was handled by municipalities in 1988.[5] Eighty-two percent (13 million tonnes) was landfilled, and eight percent (1.3 million tonnes) was incinerated. Ten percent (1.6 million tonnes) was recycled. By comparison 13% was recycled in the United States.[6] Municipalities are also responsible for hazardous household wastes. Most hazardous and other wastes generated by heavy industry are disposed of other than through municipal waste disposal systems. Provincial statutes and regulations are generally applied to these wastes.

In addition, the construction industry generated about nine million tonnes of debris and waste, and an unknown part of this was also disposed of through municipal systems. The Canadian construction industry, the Canada Mortgage and Housing Corporation and provincial governments are currently focusing major efforts on decreasing construction waste.[7]

No comprehensive Canada-wide inventory of the composition of waste exists. Table 1 provides details on the composition of residential and non-residential waste in Ontario. Ontario generates up to 45% of all Canadian solid waste, and about 43% of this is generated in the residential sector. It is evident from the classification of waste that much of waste is ultimately generated by consumer packaging: cardboard and related paper products, glass, plastic (PET), and metal. Together these products comprise nearly 40% of both residential and total waste. Only about 20% of all waste is comprised of organic food and plant substances, although most of this latter total could best be disposed of by means of community or individual composting. Newsprint comprises approximately 17% of residential waste and seven percent of total waste.

Accurate historical information on Canadian waste generation is also unavailable. It is generally accepted in the U.S. that *per capita* solid waste generation increased by 30% from 1960 to 1986, or approximately one percent per year.[8] One of the most significant trends was in the rise of plastic, which increased from .01 lbs./person/day in 1960 to .32 in 1988. Paper and paper board accounted for over 43% of the increase. The generation of wet garbage was generally stable over this long period. Food waste decreased from .17 to .13 kg/person/day, while yard wastes increased from .28 to .32 kg/person/day. Successful implementation of the 4 Rs in Canada would likely represent the first reversal of constantly increasing solid waste generation in contemporary history.

Waste Generation and Environmental Practices of Prairie Residents

To provide a baseline against which to assess future waste minimization activities, Statistics Canada undertook a survey of local government waste man-

TABLE 1: COMPOSITION OF WASTE, 1989

	Residential		Commercial Institutional Industrial		Total	
	000 tonnes	%	000 tonnes	%	000 tonnes	%
Paper Products	1474	36	1221	23	2695	29
(Old cardboard)	(108)		(441)		(549)	
(Fine)	(74)		(354)		(428)	
(Newsprint)	(673)		--		(673)	
(Other)	(619)		(426)		(1045)	
Wood	47	1	1130	21	1177	12
Construction	64	2	--	--	64	1
Diapers	111	3	--	--	111	1
Glass	291	7	282	6	573	6
Plastic	252	6	163	3	415	4
Plant, yard	1279	32	600	11	1879	20
Metal	263	6	599	11	862	9
Tires	1	neg	88	2	89	1
Household hazardous	23	neg	--	--	23	neg
Other	247	6	1278	24	1525	16
	4052	99	5361	1009	413	99

Source: Ontario Ministry of the Environment, 1989.

agement practices and of packaging in 1990, and a survey of household environmental practices in 1991.[9]

A major part of the household survey focused on household recycling activities with respect to old newsprint, metal cans, glass bottles and plastics. There was considerable variation by province with respect to recycling each of these items, and the results are displayed in Table 2. Nationally, from 42 to 53% of Canadian households had access to recycling opportunities for the four classes of waste, and over 85% of those with access practiced recycling. In the Prairie provinces, access to paper recycling opportunities was generally less than for the nation as a whole, but access generally matched that of the nation for the other three commodities. However, a significantly smaller proportion of residents of the three Prairie provinces took advantage of the recycling opportunities available than for the nation as a whole.

Both access and use varied considerably across the three provinces. Use of facilities varied between 77 and 84% for Alberta, and Albertans generally made better use of available recycling opportunities than did residents of the two other Prairie provinces. Only 47 to 59% of Manitobans made use of available recycling facilities for the four commodities, and only 38 to 44% of Manitobans, considerably below the national average, had access to recycling opportunities. Albertans appear to have the nation's greatest access to recycling facilities for hazardous household wastes, and they make good use of that access.

Overall, waste recycled as a proportion of total waste collected averaged nine percent for the nation and varied from four percent for five cities in the Atlantic provinces to 13% for the 37 participating Ontario cities. It was six percent in the seven participating Prairie cities. Data disaggregated by Census Metropolitan Area (CMA) show that use of newspaper recycling opportunities was 55% in Winnipeg, 75% in Calgary and 89% in Edmonton. The national average was 86%. Some of the reasons underlying these patterns will be explored below in a short discussion of the practices and policies of the three cities.

Waste minimization is significantly influenced by markets for re-used or recycled products. Considerable effort has gone into the development of markets, and local and regional success in recycling depends on these markets. The national packaging survey, for instance, shows that *per capita* consumption of packaging material is below the national average in the three Prairie provinces, but the proportion of packaging recycled is less than in any other of Canada's major regions (Table 3). The lack of markets may be one reason for lesser recycling activity in the Prairie region.

TABLE 2: RECYCLING ACTIVITY IN CANADA AND THE PRAIRIE PROVINCES

	Canada %	Alberta %	Manitoba %	Sask. %
PAPER RECYCLING				
Access	53	51	40	38
% w/access using	86	77	50	70
METAL CAN RECYCLING				
Access	49	52	42	56
% w/access using	86	83	56	74
GLASS BOTTLE RECYCLING				
Access	50	54	38	54
% w/access using	86	84	47	74
PLASTIC RECYCLING				
Access	42	46	44	50
% w/access using	85	79	59	71
HAZARDOUS WASTE RECYCLING				
Access	26	45	19	32
% w/access using	52	54	46	45

Source: Statistics Canada, Household Environment Survey, 1991

Waste Collection, Recycling and Disposal in Calgary, Edmonton and Winnipeg

Table 4 summarizes total collections, recycling activity and landfill disposals for 1992. The data are not strictly comparable.[10] It would be desirable to depict trends in waste collection and disposal, but the available data probably say more about levels of economic activity and trends than they do about waste and waste generation, conservation and recycling trends. Non-residential waste generation is especially sensitive to economic and construction cycles.[11] Nevertheless, the most striking observation is the apparent low level of recycling activity in Calgary and Winnipeg and the considerable activity occurring in Edmonton. Major variables appear to be ease and cost of consumer access to recycling facilities. Significantly greater use is made of facilities with curbside pick-up. The policies and programs of each of the three cities, the decisions taken by local councils with respect to waste minimization, and the motivations for these decisions are reviewed briefly in the following.

Edmonton. Waste minimization efforts of the City of Edmonton amply and simultaneously illustrate both the motivating role played by a shortage of landfill capacity and the limitations imposed by the need to raise the funds for municipal waste minimization efforts from local property taxes.

The only current public landfill operating in the Edmonton area was opened in 1975, and civic administrators were well aware by the early 1980s that a replacement(s) had to be found. This urgency, as well as the commitment of the municipal council to the four Rs, motivated the implementation of the blue box curbside recycling program as early as 1990. The resulting diversion of waste, as well as declining waste generation associated with the economic downturn of the 1980s and the willingness of Alberta public health and environment authorities to agree to plans to extend the

life of existing landfills, has allowed the civic administration to avert a waste disposal crisis. In mid-1993, civic politicians were still considering both an alternative regional site southeast of the City and an offer from an outlying county to accept Edmonton's solid waste.

Edmonton City Council adopted a waste management master plan in 1991, containing recommended programs for diverting 38 to 49% of waste by 1994. The lower proportion was applicable to a regional effort, while the higher diversion target was specified should the City not be able to join its efforts with those of its region. The plan also assumed that the entirety of the waste collection and disposal operation would be operated as a non-profit public utility, financed through user charges. It was anticipated that user charges would be progressively structured to promote waste minimization at source in addition to recycling. It was also planned that Edmonton would move to a wet/dry collection system beginning in 1993. The total cost of waste management was projected to increase from $25,232,000 in 1991 to $31,878,000 in 1994 should the regional approach be realized, or $41,146,000 should the City have to proceed independently. Basic collection and disposal cost was slightly under $14 million in 1991, and the remaining costs were attributable to public education, recycling, composting and other waste minimization efforts.

Edmonton's recycling efforts, financed entirely from the local property tax base (less offsets from marketing of recycled commodities), have more than matched those of most other Canadian jurisdictions. In 1992, for instance, almost 19% of residential waste and 13% of non-residential waste was diverted by recycling. The two largest components of the 42,000 tonnes of residential waste recycled consisted of 28,000 tonnes of commodities collected in blue boxes and almost 13,000 tonnes of yard waste collected in clear plastic bags for composting.

However, the City has been hampered in its efforts fully to implement the waste management master plan by the refusal of a Council majority to concur with the plans for turning waste management into a public utility. The waste management system continues to be supported by its property tax base. In 1993, for instance, the separate collection and recycling of yard waste was suspended in an effort to contain property tax increases. This latter event probably demonstrates better than anything else the shortcomings of continued reliance of waste management on property taxes. It also likely demonstrates the need for considering financing alternatives not as reliant on municipal administrations without leverage with respect to many aspects of the waste management system, most notably the waste generation aspects. As will be seen below, waste minimization efforts in Calgary and Winnipeg are even more graphic illustrations of these limitations.

TABLE 3: CONSUMPTION AND RECYCLING OF PACKAGING, 1990

Region/Province	Total Consumed Per Capita (000t)	% Recycled
Atlantic	.36	5
Quebec	.51	9
Ontario	.58	18
Prairie	.43	4
Manitoba	.47	6
Saskatchewan	.33	5
Alberta	.44	4
BC	.41	11
Canada	.50	12

Source: Statistics Canada, National Packaging Survey, 1990.

TABLE 4: WASTE COLLECTION AND DISPOSAL, THREE PRAIRIE CITIES, 1992

	Calgary (000t)	Edmonton (000t)	Winnipeg (000t)
Residential Waste	191	213	264
Recycled	- 5	- 42	- 6
Disposal	186	171	258
Non-Residential Waste	444	378	na
Recycled	- 2	- 48	na
Disposal	442	321	262
Total Disposal	628	492	520
Per Capita	*.88*	*.79*	*.84*

Source: Calculated from 1992 Annual Reports

Calgary. There currently appears to be no shortage of landfill capacity in Calgary, and the smaller effort devoted to waste minimization likely reflects this reality. Calgary currently operates four landfill sites in the four quadrants of the City, thus also minimizing the need for transfer stations in its waste collection system.

City Council and the civic administration have nevertheless taken seriously the need for waste minimization, although their willingness to incur additional costs has been understandably less than that of Edmonton. The data in Table 4 likely understate the impact of Calgary's current efforts, as the extensive depot recycling system that Calgary now possesses was not formally authorized until mid-1992, and the City still did not have all of the 42 planned depots in operation at the end of 1993.

Calgary's most notable contribution to knowledge with respect to recycling was the operation of a controlled pilot program comparing the costs, benefits

and performance of curbside pick-up and depot recycling (Table 5). Based on the results of the pilot program and the conclusion that drop-off was considerably less expensive and is accessible to a larger share of the population (apartments and small businesses as well as houses) civic administrators recommended the implementation of a full-scale depot drop-off program. Together with increases in tipping fees to $35/tonne (1993), it was felt that Calgary had made a strong beginning towards implementing a waste minimization plan.

TABLE 6:
CURBSIDE AND DROP-OFF COMPARISON TO EVALUATION CRITERIA

Criteria	Curbside	Drop-off
Participation	72% Accessible only single family-fourplex (R1-R4).	47% minimum. Accessible to all housing forms.
Costs	$213-$243/tonne (projected).	$118/tonne (projected).
Material Quantities	11-13% of residential waste stream (projected).	9-11% of residential waste stream (projected).
Material Quality	Minimal contamination.	Minimal contamination, but slightly higher than curbside.
Public Acceptance	88% of general public.	85% of general public.

Source: City of Calgary, *Final Report: Pilot Residential Recycling Program*, p.41.

Winnipeg. As was noted above, Statistics Canada's 1991 Household Environment Survey found that participation rates in recycling programs were generally lower in Winnipeg than for any other of Canada's 15 largest cities. Lack of recycling opportunities is generally given as the reason. The civic administration decided not to follow up a 1989 demonstration of curbside recycling after carefully assessing the costs of a full-scale program. A number of small private companies offer curbside recycling services, and it is estimated that 10% of Winnipeg households in single homes purchased these services (usually around $5-6/month) in 1992. In July 1992 the civic council authorized the establishment of up to six recycling depots.

In 1990 the civic council adopted a waste minimization and recycling action plan that had as its objective the reduction of waste disposal by 34% by the year 2000: six percent from curbside and depot recycling; five percent from industrial/commercial/civic recycling programs; two percent from wood and brush chipping; ten percent from central composting; and 11% from other, principally source reduction. Council and the civic administration have proved reluctant to implement any measures that would add to property tax rates, already the nation's highest relative to *per capita* incomes of Winnipeggers.

It is in this last context that the civic administration and provincial government both welcomed and promoted the bid by the Grocery Products Manufacturers of Canada (GPMC) to make Manitoba the first site in North America for the introduction of a "packaging stewardship model." The program anticipates province-wide recycling services for three fourths of Manitoba's households and two processing plants in Brandon and Winnipeg. Cost estimates are based on a promise of no new recycling costs for municipalities and are anticipated to reach $5.5 million annually by the third year of implementation.

Public Policy for Waste Minimization

Historically, municipalities and municipal taxpayers have borne the cost of providing local services, including waste collection and disposal, at least for occupants of single family houses. The cost of collection and disposal was generally included in municipal budgets. The bulk of any funds required came from municipal revenues, and the main revenue source for municipalities is the property tax. The objective of municipal administrators was to collect and dispose of waste as efficiently and effectively as possible. In the case of Calgary, Edmonton and Winnipeg the cost of collection services ranged from $28 in Winnipeg to $47 *per capita* in Calgary and Edmonton in 1991, or from 2.7 to 6.5% of total municipal (non-school) spending. The main issue for most municipalities stemming from increasing concern for minimizing waste is who will pay for the increased costs associated with public education, recycling and recovering value from waste.

Minimizing waste entails additional costs. As was seen above, the limited waste minimization and demand activities currently undertaken by major Prairie cities, principally collection of recycling wastes from special depots and from specially designated recycling boxes at curbside, costs from $120 to $250 per tonne of recycled waste (compared to $60-80 for basic residential garbage collection and disposal) and adds considerably to total municipal waste collection and disposal bills. As is the case with the base cost, additional costs up to now have also largely been borne by the three Prairie cities.

The public policy challenge is the raising of revenues to compensate municipalities, as well as the larger waste management system, for the additional costs associated with "sustainable development" practices. The principal argument opposed to charging these costs against increased property levies is that to do so would amount to charging resource conservation and good environmental practice to citizens as consumers. Society as a whole is the main beneficiary. A related issue is the principle of benefit taxation. It is the view of many tax theorists that property taxation, the predominant source of municipal revenue, has a very legitimate presence in the overall Canadian taxation system as a benefit tax.[12] It would, however, be inequitable to charge property tax where the beneficiary was either society generally or a small group of property owners, namely manufacturers, wholesalers and retailers who are the primary generators of waste.

A related issue of equity is that in much of Canada, including the three Prairie cities considered here, municipal collection of waste from multi-family residential properties and most waste generated by commercial, institutional and industrial properties is the responsibility of the owner or occupant. Many observers consider it inequitable that multiple and single family residential uses, which are frequently assessed for taxation purposes in a similar manner, already enjoy different benefit levels from municipal services. Single family residences receive full collection and

waste disposal services from municipalities, while many multiple family residences and apartments, including owned apartments, frequently receive no collection services and must, in addition, pay tipping fees which are then used to underwrite the costs of single family waste disposal services. An already inequitable policy with respect to a service that consumes less than three percent of total municipal spending becomes absolutely reprehensible as the cost of the service doubles in municipal spending budgets.

Many municipalities–as many as 1,800 in the U.S. and municipalities in Canada such as Victoria (B.C.), Lethbridge (Alta.) and Nanaimo (B.C.)–have resolved the issue of who pays and how much by treating waste collection as a public utility and placing it on a full or partial user-pay basis. Partial user-pay systems typically provide a basic level of service from which revenues are derived from property taxes and charge "users" for greater services (more bags or cans of garbage). A full-recovery public utility would require municipalities to raise the entire cost of waste collection and disposal from user fees in much the same manner that water and/or sewer utilities currently function in most Canadian local jurisdictions.

While the latter treatment of waste collection and disposal would reduce or eliminate the cross-subsidies that are frequently a source of inequity between different land uses or residential building types, it also transfers the incremental cost of good environmental practice from the producers of waste to tax payers as consumers. Stewardship is seen as the answer to this latter issue by some observers.

Stewardship

One of the tensions between the objective of reducing, re-using, recycling and recovering increasingly scarce societal commodities and resources and wasteful practices that have proven to be environmentally harmful is that while private companies have traditionally made the decisions about the manufacture and distribution of consumer and producer products, governments and/or unwitting consumers have assumed responsibility for dealing with the waste that is created. The concept of "stewardship" has been discussed as a means of more equitably sharing responsibility and of addressing this basic tension undermining the objective of waste minimization.[13] Stewardship is the principle underlying the German Federal Republic's "green dot" system, perhaps the world's most progressive and effective waste minimization regime. Producers are required by law to accept responsibility for disposal of consumer packaging waste.

As was seen above, two characteristics distinguish the approach of Prairie cities to waste minimization. Firstly, pressures presented by the absence of landfill capacity are on the whole not present to the extent that they are in many other more urbanized regions. Secondly and not unrelated, there has been a reluctance to incur additional public costs, although there appears to be a certain amount of support for substantially increasing waste minimization efforts in the context of a public utility approach to waste management, associated with waste minimization.

These conditions have provided fertile ground for the notion of stewardship. Manitoba was well-placed for the GPMC stewardship demonstration. Other jurisdictions have been under pressure to obtain more immediate results. Thanks in large part to the work of the Recycling Action Committee, which developed "A Waste Management Strategy for Manitoba in the 1990s," stressing co-operation and shared responsibility between manufacturers, waste generators and government, Manitoba's Waste Reduction and Prevention Act, 1991, enshrined the stewardship approach in legislation. At the same time Manitoba is one of only two provincial jurisdictions in Canada without container deposit legislation. The GPMC hope to demonstrate that mandatory legislation or regulation is unnecessary and that the stewardship model can achieve reduction and recycling outside of a regulatory regime.

The ultimate challenge for Manitobans and the provincial government will be to maximize front-end reduction of waste and good environmental habits while the GPMC are a financial participant, as it is virtually certain that the industry's financial support will be withdrawn at some future date and/or when current waste minimization targets are met. The entrenchment of incentives to reduce, recycle and recover while the planned program is in effect will assure the achievement of objectives. The creation of waste management utilities is undoubtedly a part of this process, although proposals for such in Winnipeg and the unwillingness of Edmonton council to approve this approach in 1990 are evidence of the need to introduce alternative models to an increasingly cynical public in the context of revenue neutrality.

While stewardship may successfully spread the cost of waste minimization among societal sectors in a more equitable manner, it may ultimately prove to be an unstable regime. Similar efforts in Ontario have not been able to provide a steady funding base for municipal waste recycling. Provincial resolve is undoubtedly critical to success of the stewardship model. So also is the objective of waste reduction as superior to recycling and recovery as waste minimization strategies.

Jeffrey Patterson
Senior Research Fellow

NOTES

1. Angus Reid Group, *The Urban Canada Report: The Views and Attitudes of Residents of Eight Major Cities in Canada* (Winnipeg: The Group, 1991).

2. Cf. Jeffrey Patterson, *Preferred Environmental Actions of Urban Canadians* (Winnipeg: Winnipeg Area Study, Department of Sociology, University of Manitoba, Research Report No. 46, 1993).

3. Linda Derksen and John Gattrell, "The Social Context of Recycling," *American Sociological Review*, 58 (June 1993): 434-42.

4. The Global Cities Project, *Building Sustainable Communities: An Environment Guide for Local Government*, March 1991 (San Francisco: Center for the Study of Law and Politics, Vol. 2, "Solid Waste: Reduction, Reuse and Recycling").

5. Environment Canada, *The State of Canada's Environment* (Ottawa: Environment Canada, 1992), p. 25-5.

6. World Resources Institute, *The 1992 Information Please Environmental Almanac* (Boston: Houghton Mifflin Co., 1992), p. 108.

7. Cf. R.E.I.C. Consulting Ltd., *et.al., Making a Molehill Out of a Mountain: Reducing the Volume of Residential Construction Waste Designated for Municipal Landfill Sites* (Toronto: Report Prepared for the Toronto Home Builders' Association, 1991).

8. Ibid.

9. Craig Gaston and Alan Goodall, "Local Government Waste Management Practices Survey," and Marcia Santiago, "Household Activity, Household Expenditures and the Environment," in Statistics Canada, *Environmental Perspectives 1993: Studies and Statistics*, 1993 (Cat. 11-528E Occasional), pp. 69-78, 53-68.

10. While each of the three cities maintain similar policies and programs under which the municipality assumes responsibility for collection from single detached homes and other related waste generators. Each city maintains sanitary landfills that receive waste from municipal collections, as well as from collections from non-residential generators where collection is not under government auspices. However, collection programs differ in their details. As well, the three cities also receive waste from generators outside municipal boundaries. The data are therefore not strictly comparable.

11. For instance, waste disposal in Edmonton decreased by nearly 31% from 1981 to 1982, but this may have been due as much to the arrival of recessionary times as to any local government policies. Disposal quantity decreases in the early 1990s may likewise be due to a number of factors, one of which is the coming of yet another recession. As well, all three cities have increased tipping fees significantly, and these increases may in fact have had the desired effect of encouraging waste minimization. In the case of Edmonton, a shortage of landfill capacity may have resulted in the diversion of waste not collected by the municipality to other areas.

12. Ontario, Fair Tax Commission, *Final Report*, 1993, contains one of the most comprehensive discussions available of the place of property taxation in the overall taxation system.

13. Cf. John Sinclair and Glen Koroluk, "Canadian Packaging Initiative Seeks Reduction, Recycling," *BioCycle* (November 1993): 74, 75.

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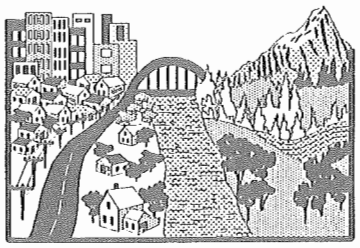

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